business solutions for a sustainable world

Energy Efficiency Toolkit for Corporate Buildings

Version 1

"A How to Guide"

wbcsd buildings

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With support from

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Disclaimer

This version 1 of the toolkit will soon be turned into an online interactive material, and additional case studies from companies will also be added in the coming months.
For any question, or if you want to provide a case study on any of the different steps, please contact Roland Hunziker, EEB Director, WBCSD at hunziker@wbcsd.org

Contents

1 Introduction

1.1 Why Energy Efficiency in Buildings Matters & Need for a Toolkit

Buildings consume 35% of the world's energy, which represents one third of global man-made CO_2 emissions. Consumption is rising fast in particular as the world's most populous and fast-growing countries urbanize rapidly. Yet, energy efficiency is an often neglected source of energy savings and a hidden cost in many organizations.

Important improvements in building energy efficiency are possible with positive rates of return. This toolkit provides a step-by-step guidance on how it can be done, including examples for the types of paybacks that can be achieved with systematic and focused energy efficiency investments.

Many case examples have been published that portray successful energy efficiency measures. However, most case studies look at technical measures and technical performance indicators, while giving no or only partial information about financial as well as other benefits that arise from these measures.

Other case examples also often forget the corporate strategic / organizational aspects that can have a major impacts on the decision of EEB investments. This toolkit also addresses these issues (which is mainly dealt with in the "Vision & Goals" part.

This toolkit looks at the business case for energy efficiency. It addresses those people within an organization who are the decision makers on corporate investments and those people who prepare these decisions.

1.1.1 Goal of the Toolkit

The goal of this toolkit is to be "a guide to energy efficient investments in buildings". The primary objective is to help decision makers in a corporate environment to address issues which save energy in a financially viable manner, allowing for reasonable returns on investment.

1.1.2 What the Toolkit IS

- A framework to help decision makers to accelerate the reduction in energy consumption in their new or existing buildings.
- A practical guide to help energy managers work with decision makers to ensure that the energy efficiency measures being undertaken not only save energy but are also financially viable.
- A step-by-step approach to developing an energy efficiency program with specific toolsets to achieve the goal of energy savings
- A comprehensive look at energy efficiency, ranging from vision, strategy and goal-setting to financial assessment, implementation and the critical role of management.

1.1.3 What the Toolkit IS NOT

- A list of energy efficient solutions
- A promotion of specific companies proposing these solutions
- A technical guide

1.1.4 Audience

The primary audience for this Toolkit are medium to large corporations who have a sizeable real estate portfolio –either wholly owned, operated and managed by themselves or wholly owned but operated and managed by a professional real estate management company.

Real estate management companies who are managing large tracts of commercial office buildings could also find the toolkit valuable.

The toolkit addresses both new construction as well as retrofits of existing buildings. In its current form, the toolkit is primarily applicable to corporations who own and manage their buildings on a long term basis.

It is only partially applicable for corporations who (1) do not own the buildings but only lease them, (2) own and manage the buildings but lease them to third parties, or (3) own the buildings but the management is done by a third party FM company or (4) are purely lease tenants, with the physical real estate being owned and operated by a third party. In a future edition, it will also address how the above scenarios could be addressed with a larger goal of energy efficiency.

Finally, the overall economic context is important – how long is the current scenario going to last, and what is the horizon for economic return ?

1.2 About WBCSD

The WBCSD is a CEO-led organization of forward-thinking companies that galvanizes the global business community to create a sustainable future for business, society and the environment. The Council provides a forum for its 200 member companies - who represent all business sectors, all continents and combined revenue of over $US 7 trillion - to share best practices on sustainable development issues and to develop innovative tools that change the status quo. It plays the leading advocacy role for business. Leveraging strong relationships with stakeholders, it helps drive debate and policy change in favor of sustainable development solutions. The Council also benefits from a network of 60 national and regional business councils and partner organizations, a majority of which are based in developing countries.

The WBCSD Energy Efficiency in Buildings project works with owners and managers of large building portfolios across different market segments as well as building market stakeholders to analyze the decision-making process for energy efficiency measures, to identify the key barriers and develop recommendations on how to overcome them. This Toolkit is one of the levers for action and commitments on the task of cutting energy use in buildings.

1.3 How to Use the Toolkit

This section describes the toolkit in brief. A more detailed discussion on the different steps and stages is provided throughout this guide in subsequent sections and chapters.

(1) Staged Step by Step Approach with Executive Management Support
(2) Focus on Financials / Business Case Analysis
(3) Case Studies with Business Imperatives and Technologies
(4) A detailed “Toolset” is provided at the end of this guide providing detailed analysis on the key aspects for a successful program on Energy Efficiency in Buildings.

1.3.1 Navigating the Toolkit

Since users maybe at a different level of maturity in their energy management journey, the toolkit is specifically designed to enable entry at any given step within any stage of the process.

The users therefore need to use the toolkit to first establish which stage their corporation is in and within each stage, which step of the process they are currently engaged in. Once this is established, the users can insert into whichever step of the process they are in and move forward.

In the event that some earlier steps or aspects have not been done, the user can then decide what the best way to perform those specific activities is. For example, on an ad-hoc, one-time manner to move forward quickly. The end results from this project will then be analyzed and presented as feedback to the executive management who approved and funded the projects in the first place. This process is done on a project by project basis and is therefore a continuous cycle. The management briefings can be scheduled to be every quarter or twice yearly depending on the project cycle.

1.3.2 Staged Step By Step Approach

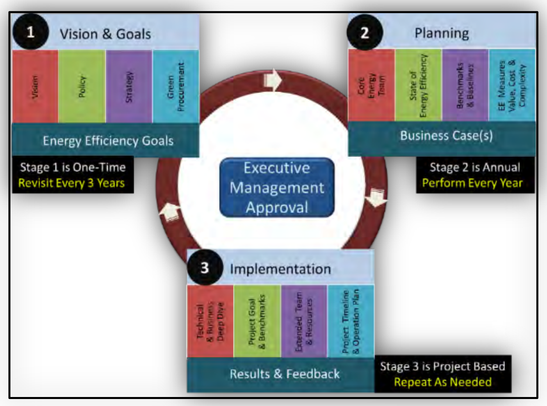

Figure 1.1 : Overall Step by Step Approach for Energy Efficiency Program

The toolkit has been designed in the form of a step by step guide. As shown in Figure 1.1, there are three main stages

(1) Vision and Goals
(2) Planning
(3) Implementation

Each of these individual stages have specific components which are described in detail in the following sections. There is the constant guidance of executive management for activities ranging from approving energy efficiency programs to providing budget and establishing policy and strategy.

The above process is iterative in nature and in order to achieve aggressive energy efficiency goals of say greater than 50 %, will require multiple iterations through all the 3 blocks. As seen from the graphic, the Vision and goals is typically re-visited every 3 years which means the energy efficiency effort is a journey and not a quick one time program.

1.3.2.1 Stage 1 : Vision & Goals

This stage is typical for a corporation early in its journey and maturity of energy efficiency (EE). Once management has been convinced of the need for an EE program, a small group, likely 1 or 2 individuals will start to develop a vision, policies, strategies, procurement practices and eventually a set of specific short term and long term efficiency goals. This stage is typically revisited every 3-5 years to take a fresh look and see if some of the initial views on vision, policy and strategies as well as energy goals need to be modified or improved.

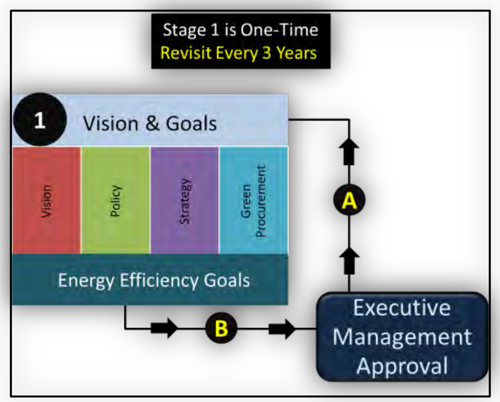

Figure 1.2 : Vision and Goal Stage with Management Approval

1.3.2.2 Stage 2 : Planning

This stage is post developing a vision, policy, strategy and establishing key corporate goal and after executive management approval to graduate to the next stage of detailed planning. Appropriate budget and resources are provided to a core energy team with different and complementary skill sets. This core team will establish the "state of energy efficiency", develop benchmarks, and conduct energy audits to establish baselines. This will lead to the identification of energy efficiency measures (EEM) which will have attributes such as value (energy and therefore $ savings), complexity (difficult to implement) and cost (investment needed up front).

Detailed business cases (with details on the EEMs being proposed, investment needed, Return on Investment (RoI), timeframes) will need to be developed and shared with executive management once again, to obtain the "go=-ahead" along with sufficient funding and resources to implement the chosen EE projects.

This stage typically will re-occur on an annual basis, as part of an annual energy review. Revised benchmarks and baselines to show continuous improvement are essential to the process.

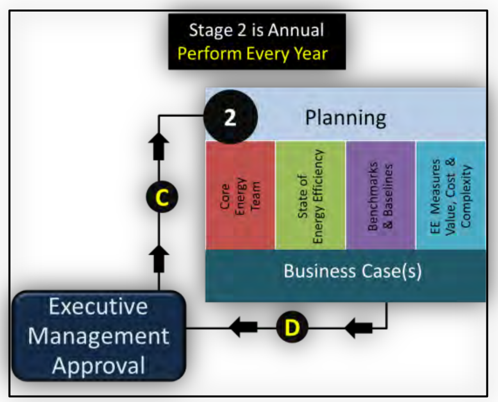

Figure 1.3 : Planning Stage with Management Approval

1.3.2.3 Stage 3 : Implementation

This stage is post approval from executive management to engage and start the actual EEMs. Each of the EEMs will be treated as a separate project, detailed technical and business analysis will be performed, project goals and benchmarks established along with an extended, highly skilled team comprising of the core energy team and other key ecosystem partners such as contractors, consultants, energy service companies (ESCOs). All of this will be put into a project plan with timeline and operational plans.

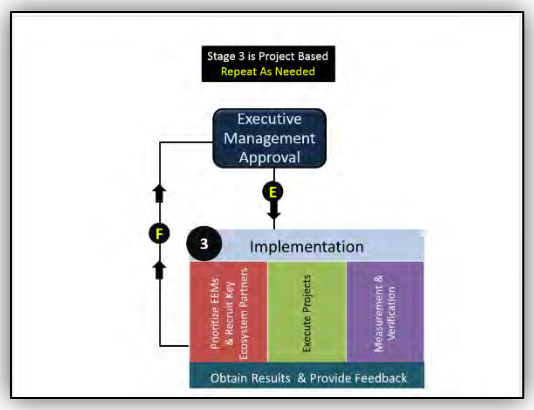

Figure 1.4 : Implementation Stage with Management Approval

1.3.3 Strong Focus on Financials / Business Case Analysis

The toolkit recognizes that in many cases, the energy team in a corporation is not financially savvy but the decisions and the information required and investment decisions made by executive management is almost always financial in nature.

Bearing this in mind, the toolkit has tried to ensure a strong emphasis on the financials and outlined in detail, approaches that the energy team can take to evaluate and pre-determine the financial viability of any given EEM. Different financial terminologies (Payback, Net Present Value, Internal Rate of Return for example) and analysis methods are outlined and the different, easy to use tools developed by the US Environmental Protection Agency (US EPA) are presented.

1.3.4 Case Studies with Business Imperatives & Technologies

It is well recognized that in many cases, energy efficiency can be very theoretical in nature and there is a need to provide real-life examples of successful energy efficiency programs as well as lessons learned. In order to fulfill this need, This toolkit has provided numerous and detailed examples / case studies from INFOSYS, a software multinational company. As other examples from other companies become available, they will be added to the toolkit in future revisions.

1.3.5 Toolset

In addition to a step by step approach, considerable supporting material has been provided in the form of “**toolsets**” at the end of the report. This reference material will be very useful for determining specific and targeted information related to sample visions, strategy and policies, financial terminologies and analysis tools / calculator, Business Plan development, Energy Audits and Baselines and also a set of common EEMs which could be used as a starting point.

1.4 About INFOSYS

Infosys is a global leader in consulting, technology and outsourcing solutions. Infosys enables clients in more than 30 countries to outperform the competition and stay ahead of the innovation curve. Ranked in the top tier of Forbes' 100 most innovative companies, Infosys provides enterprises with strategic insights on what lies ahead. It has enterprises transform and thrive in a changing world through strategic consulting, operational leadership and the co-creation of breakthrough solutions, including those in mobility, sustainability, big data and cloud computing. Services include management consulting, business process outsourcing, business application, Cloud, business IT services, mobility, engineering, and sustainability.

Infosys has a growing global presence with USD 7.4 Billion in revenues and 160,000+ employees worldwide, across 73 offices and 94 development centers in the United States, India, China, Australia, Japan, Middle East, and Europe.

The HQ of Infosys is based in Bangalore, with campuses in different locations in India such as Chennai, Hyderabad and Pune among others. The company has a real estate footprint in the excess of 32 million sq. ft built up area and is growing. Since 2008, Infosys has taken up an aggressive program on energy efficiency in buildings and achieved excellent results. The company has successfully achieved a reduction of 53.5 % in carbon intensity (scope 1 and 2), 40 % in energy intensity by 40% and 34 % in water intensity compared to 2008 levels. 58 million units of electricity have been sourced from renewable energy, air conditioning retrofits have provided a 4.8 MW reduction in connected load and 2 Million square feet of the buildings on its campuses have achieved the highest level of green building certification.

2 A Step By Step Approach

2.1 How to Create a Vision

1. Steps for the Vision and Goals Stage	5. Develop an Energy Strategy
2. Get Executive Commitment	6. Establish Green Procurement Practices
3. Create Energy Management Vision	7. Establish Energy Goals – BHAG & On The Way
4. Articulate Energy Policy	8. Presenting Results to Executive Management

2.1.1 Steps for the Vision and Goals Stage

When starting an energy efficiency program for an organization, it is essential to have a solid foundation. This is necessary and even critical to the success of the program since the energy effort is a journey and a long one at that. This means that the staying power, willingness and commitment of an organization is necessary.

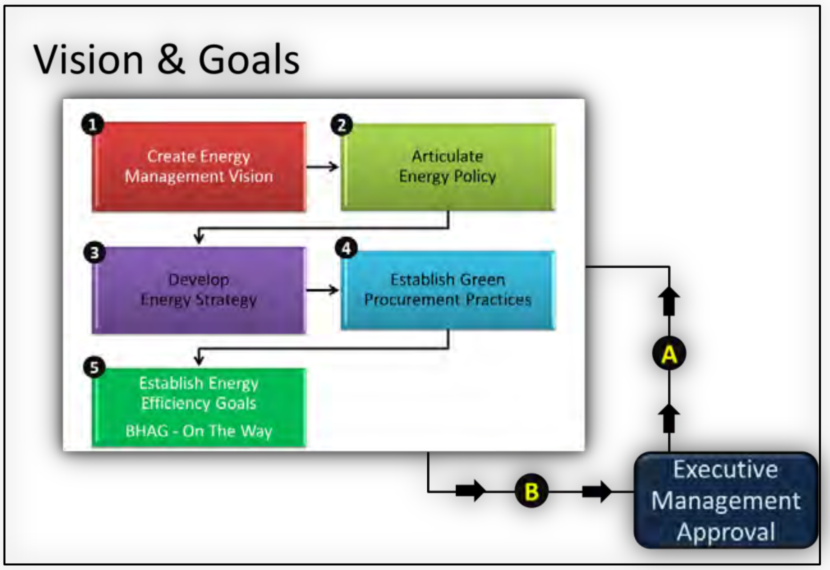

Figure 2.2 : Individual Steps for Vision and Goal Stage

As shown in Figure 2.1, there are seven (7) major steps which is a feedback loop, starting and ending with Executive Management.

1. Executive Commitment to Start an Energy Efficiency Program
2. Create an Energy Management Vision
3. Articulate Energy Policy
4. Develop an Energy Strategy
5. Establish of Green Procurement Practices
6. Establish Corporate Energy Efficiency Goals
7. Executive Approval to Move to Next Stage for Detailed Planning

2.1.2 Get Executive Commitment

Every energy program needs the backing of senior or executive management to succeed. The most effective manner to achieve traction for an energy program and demonstrate unequivocal executive support is to have CEO commitment.

The 1st step of Executive Commitment is really part of a constant feedback loop with the senior management team, where they

(1) first approve and support an effort to "start" a formal energy efficiency program and then
(2) later approve the overall vision, strategy and goals before the next stages of Planning and Implementation.

Figure 2.3 : Individual Steps for Vision and Goal Stage

2.1.2.1 Obtain CEO & Management Support to START the program

Present a simple approach to the executive management which clearly articulates the specific steps in the Vision and Goal Stage – Vision, Policy, Strategy, Procurement and the overall Corporate Energy Goals.

The "ask" needs to be for approval to kickstart the program, a base budget and some small number of staff resources, perhaps as small as 1 or 2 individuals to drive the process. Once the CEO has clearly articulated his or her support, the rest of the senior management chain will also offer their support and the program will be off to a good start. If such support from C-Level executive staff is missing, energy management will falter and become marginalized.

Such executive commitment is not only at the start of a given energy program, but continuously reaffirmed at regular time intervals which is communicated broadly across the corporation is essential.

Improving energy efficiency is one the best ways to reduce costs and increase profits. Improved energy efficiency is also often associated with increased productivity. If an energy management strategy is not pursued at senior levels, then a corporate strategy that strives to maximize returns is failing investors and stakeholders alike. Raising energy issues at a corporate level can also assist in the adoption of new cost and energy saving technologies.

2.1.2.2 Identify & Empower Champion

In the early stages of the energy journey, a very small group of perhaps just 1 or 2 staff members will need to be dedicated to the effort and leverage a virtual set of key stakeholders around them. In all likelihood, such a team will grow to a core group as outlined in the next stage (Planning), with this “champion” at the helm as as an **Energy Manager** or **Energy Director**. In some companies such an individual is termed as an “**Energy Czar**”.

The appointment of an energy manager or champion is a critical aspect of a successful energy management strategy. Such an individual must be “empowered” by the executive management to take things forward and drive the energy program.

2.1.2.3 Link between Business Case and Management Buy-In

The good news is that there is a business case for sustainability[1],[2],[3],[4]. Leading researchers from and London School of Economics indicate that in the long term, companies whose operating models include sustainability typically outperform “old school” peers. This research-proven business case is great news for the sustainability champions within an organization, who often struggle with presenting a business case for sustainability initiatives that will get the CEO and CFO on board.

Sometimes there is a distinction drawn between energy efficiency and sustainability, since strictly speaking, energy efficiency is a subset of sustainability. Executive management often indicate that energy is only of the overall environmental / sustainability experience. In such a case, the overall economics of sustainability should be considered, not just that of energy efficiency.

The bad news is that the business case alone is not enough to get organizational buy-in. Very few companies have an ingrained commitment to sustainability. This is only achieved via strong leadership commitment and vision. A good business case could help pave the way for a dialogue with executive management, but needs to be coupled with the executive “will” to make it happen. A commitment to innovation and high levels of trust in the organization are more likely to embed Sustainability in their Corporate DNA[5].

This theme of management buy-in and the strong need for a viable business case for energy management will reverberate throughout this guide to underscore the critical need to have sustained and continuous executive support with sound financial reasoning.

2.1.2.4 Ways to Convince Senior Management

Sustainability transformation essentially is a top-down approach that starts with a commitment from the Chief Executive Officer and Board. It includes aligning sustainability to the company's strategy and core values, and ensures company-level accountability, ideally through the appointment of a Chief Sustainability Officer. It also includes the setting up of a governance

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[1] Eccles, Krzuz and Serafeim, Harvard Business School, Sep 2011: ‘Market Interest in Nonfinancial Information;

[2] Eccles, Ioannou and Serafeim, Harvard Business School, Nov 2011: ‘The Impact of a Corporate Culture of Sustainability on Corporate Behavior and Performance;

[3] Cheng Ioannou and Serafeim, Harvard Business School, May 2011: ‘Corporate Social Responsibility and Access to Finance’;

[4] Bauer and Hann, Maastricht University: December 2010: ‘Corporate Environmental Management and Credit Risk’.

[5] Eccles, Miller Perkins and Serafeim, MIT Sloan Management Review, Summer 2012, ‘How to Become a Sustainable Company’

structure that addresses areas such as skill development, budgeting, change management, stakeholder engagement, employee engagement, innovation and execution focus.

2.1.2.5 Case Study – INFOSYS : Executive Commitment

- "At Infosys, sustainability is a way of being. It is not something we do beyond business; it is about our business. The urgency to build and carry forth a sustainable business model at Infosys is here to stay….. What businesses like ours do over the next decade or so will determine how close we can get to our goal of creating a sustainable planet. Our targets must be aggressive, our actions focused. [6]
  - ***S. Gopalakrishnan***, Executive Vice Chairman, Infosys Limited.

- Sustainability is not a reaction to our risks. It is our core value. - ***S. D. Shibulal***, Chief Executive Officer, Infosys Limited.[7]

Statements as strong as these from the highest executive echelons of management of a company are clear examples of the commitment to environmental sustainability imbibed into a company's vision and therefore culture. It demonstrates a better understanding of the connection between better environment and improved business.

2.1.3 Create Energy Management Vision

In order to have an effective Energy Plan, an appropriate Energy Management Vision needs to be created. Typically, most companies have a Vision Statement and an "energy centric" viewpoint should be established either as a separate statement or the original statement modified to incorporate energy or sustainability.

2.1.3.1 Importance of Vision Statements

There are multiple reasons as to why Vision Statements are important including:

- Guide management's thinking on strategic issues
- Help define performance standards
- Provide inspiration to employees to be more productive through focus and common goals
- Guide employee decision making
- Establish a framework for ethical behavior
- Enlist external support including community / society
- Establish a closer linkage and improved communication with key stakeholders such as customers, suppliers and alliance partners
- Serve as a public relations tool

[6] http://www.infosys.com/sustainability/leaders-speak/Pages/index.aspx

[7] http://www.infosys.com/sustainability/leaders-speak/Pages/index.aspx

2.1.3.2 Guidelines for Vision Statements

Such statements normally (all with respect to Energy and Sustainability):

- Identify the company culture, values, strategy and plans of the future.
- Establish the commitment the firm has to all of its key stakeholders, including employees, customers and shareholders and more common today also the community or society.
- Ensure that the vision is meaningful, achievable and objectives are measurable, and a plan of approach actionable.
- Communicate the message in concise and precise yet simple manner.
- Develop buy-in and support throughout the organization.

2.1.3.3 Case Study INFOSYS : Sustainability Vision

Infosys's vision is predictability, sustainability, profitability and de-risking. They call it the PSPD model. **N. R. Narayana Murthy,** the current Executive Chairman at Infosys Limited calls it the DNA for excellence at Infosys. Though the term sustainability initially meant sales and sustained profits to Infosys, the idea of a sustainable environment is very clear from the views of Mr N R N Murthy when he said "We want to give back this planet to our children in a condition better than the one in which we borrowed it from them."[8]

- The commitment for sustainability for Infosys goes beyond their campuses. They have been working with business and government leaders to build models of industry and governance.
- When setting the goal is a part of the sustainability framework development, measuring and improving it the next step. The CEO monitors progress made in this line, every quarter.

2.1.4 Articulate Energy Policy

An energy or sustainable policy is typically a well-documented and written statement which reflects the commitment from a company to manage energy and environmental or sustainable impacts. One of the best ways to demonstrate executive support for sustainability and/or energy management is to have the CEO approve and sign a broad policy statement on the subject. It documents the CEO's true commitment to the topic.

2.1.4.1 Reasons to have an Energy Policy

There are several reasons why an organization benefits from the adoption of a formal, written Energy Policy including :

- A clear-cut statement will give a sense of purpose that will enhance chances of success
- Senior management can judge the performance of its strategy against an agreed set of targets
- Energy reduction matters are more likely to be understood and accepted throughout the organization if they have the support of senior management.
- Activities will be more successful if adequate resources are allocated to energy management.

[8] http://www.infosys.com/sustainability/leaders-speak/Pages/index.aspx

An energy policy lays the foundation for best practices in energy management. An effective policy will have direct relevance to the company and appropriate to its nature and size :

- A clear expression of the organization's energy/carbon vision and aspirations, with specific objectives, for example:
  - to go beyond basic legal requirements;
  - quantitative targets or a commitment to develop and adopt such targets;
  - the adoption of qualitative public commitments or external recognition/accreditation schemes or standards.
- A commitment to develop and continuously maintain a "current" energy strategy by ensuring a common energy decision approaches across all relevant decision making.
- A commitment to ensure that there will be sufficient resources – both staff and other, to meet policy objectives.
- A commitment towards appropriate training and development needs of staff including raising energy awareness of employees.
- A commitment to regular and formal reviews – for example an annual policy review to study if needs to be modified or adapted depending on the then current market conditions and dynamics.

2.1.4.2 Parts of an Energy Policy

An energy policy should be short and succinct - typically not to exceed 2 pages and in cases for small to medium businesses, it may be as short as 2 to 3 paragraphs. It has 2 parts :

- **Part A**: A statement which documents the guidelines and principles to which the company is committing to. It must demonstrate the support from executive or senior management and provide the framework for the delivery of energy savings.
  - Declaration of senior management's commitment to, and middle management's involvement in energy management.
  - Clear accountability for energy management, with a senior manager nominated for energy management responsibilities within the company.
  - Statement of Policy
  - Short Term Objectives (less than 3 years) and
  - Long Term Objectives (more than 3 years)

- **Part B**: A more detailed document setting out specific energy management objectives and targets along with the methodology for achieving these. It should provide clear information about who is responsible for the delivery of the policy, detail of actions, and a timeframe for review.
  - Specific designated staff members, responsibilities and accountabilities.
  - An actionable and realistic plan with a timetabled program for increased energy efficiency and performance. For example, a goal of an annual reduction in energy consumption and cost of 5–10% for a period of 3 years, with a step by step detailed plan on how to get to the end goal.
  - Firm statement that allocation of funds for energy efficiency projects will be given preference
  - Systematic method to measure (record), analyze (evaluate) and control energy consumption on an ongoing basis, with regular reviews held by management.

- Annual Performance Reviews by senior management with appropriate deep dives on existing energy use, opportunities for cost effective investment and performance appraisals for key staff members.
- Account for the cost for resources including communication of the benefits of energy efficiency to employees, staff training to those tasked with implementing the action plan.
- A detailed stakeholder matrix including the energy management committee's structure and membership. Also include different "key personnel" and their contact information in the different departments.
- A system to report and communicate energy performance figures to employees and key stakeholders.

2.1.4.3 Case Study : INFOSYS : Sustainability Policy[9]

Infosys Sustainability Policy

We formulated the Infosys Sustainability Policy this year with the objective of being a responsible, leading global organization working towards the greater common good by setting global benchmarks for a *sustainable tomorrow*. The policy will build a diverse, social and ethical workplace, work towards a sustainable ecosystem and create stakeholder value.

This policy will become effective from July 01, 2010.

Scope

This policy covers all Infoscions, our vendor partners and contractual partners across various geographies.

Background

The sustainability policy works in concert with various other policies in existence and follows our philosophy of maximizing value to our stakeholders — our clients, employees, investors, vendor partners and the society, in their context — while adhering to our values, social contract, upskilling people, ensuring resource efficiency through innovation, and keeping our environment green for a sustainable future.

Our sustainability policy will be driven by:

- Our values
- Our social contract
- Our focus on innovation, while improving resource efficiency and keeping our environment green.

Eligibility

All Infoscions across various job roles from the fresh entrant to the members of the Infosys Board of Directors are included in the policy.

Policy details

We are aware that while actively handling global challenges, we have to ensure that what we do today has a positive impact on tomorrow for us and the world by enhancing global sustainability practices.

Making our business sustainable

- We follow the PSPD model of profitability, sustainability, predictability and de-risking our business while ensuring a green planet.
- We have set in place several policies for positive engagement with our employees

Making our clients' business sustainable

- We want to enhance business value leverage to our clients, from transactions with us, while ensuring sustainability for them by helping them achieve their sustainability goals.

Making our ecosystem sustainable

- We will work on reducing our per capita consumption of electricity, water and carbon emissions, with a long-term goal to becoming water sustainable and carbon neutral.
- We will invest in green buildings and datacenters to effectively utilize natural resources
- Being a socially conscious organization, we will contribute to society through the Infosys Foundation, Infosys Science Foundation and other such initiatives.
- We will raise community empathy through employee volunteering programs.
- We will encourage our vendors to become more focused on their green initiatives.

Making our lifestyles sustainable

- We will conduct camps and awareness programs to help the members of the Infosys family to become proactive about their health, wellbeing and reduce their ecological footprint.

2.1.5 Develop an Energy Strategy

A policy on its own will not deliver energy savings. A policy only provides the mandate and focus for the development and implementation of an energy management strategy. Following approval of the policy, the next immediate step is an actionable working strategy. It should be noted that at this stage, the strategy is more of the "what" and not the "how" of the process, which is covered at length in the next section – **Planning**.

[9] http://www.infosys.com/sustainability/Documents/infosys-sustainability-policy.pdf

2.1.5.1 What is an Energy Strategy

An energy strategy is a working and living document which clearly outlines the "how and what" of an energy management plan. Its contents will include a baseline or understanding of the organizations' current energy status, action plan of tasks, and establishing the management framework. As the various processes and approaches are established, the tasks start to should address which energy projects should be tackled and implemented first.

The details to creating an energy strategy is very specific to each organization and has a dependence and relation to the corporate culture, its stage of maturity of energy management it has reached. Therefore a successful strategy which will form part of the energy management framework, may have a range of options, instead of a single path.

2.1.5.2 Typical Components of an Energy Strategy

Whatever the organization's starting position, the following aspects are likely to be a part of the strategy :

- Recognition from management that energy use is just as important as any other aspect of the business;
- Assignment of energy roles and responsibilities across the organization with resources allocated to ensure that these responsibilities can be properly delivered. This includes staff time, staff grades and budgets.
- Voluntary compliance to demanding energy certifications or labels, or by default compliance with energy and carbon regulation required by law.
- Estimation and allocation plan for investment into projects needed to achieve the full potential of the energy efficiency projects – in a cost effective manner.
- Ensuring that development and maintenance of procedures for the procurement of buildings, equipment and services for the organization has cognizance of energy efficiency and energy related costs.
- Development and maintenance of organizational structures including day to day operations, capital financing of energy efficiency activities and projects, consistent with the policy goals.
- Implementing a system of reporting and monitoring energy flows and use. This is sometimes referred to an Energy Information Management System (EIMS) and can include measurement (metering), monitoring (recording), analysis and reporting of energy performance and related issues such as benchmarking.
- Standardized methods and processes including a detailed energy audit for identifying energy reduction opportunities which are reasonably straightforward and easy to implement.
- An ongoing plan containing a number of energy saving projects derived from the audits conducted.
- Adequate training and development for staff who are tasked with the different aspects of the energy policy and strategy.
- Robust communications plan to showcase and demonstrate the energy policy, targets and particular initiatives both within the organization and outside as needed.

2.1.5.3 Case Study INFOSYS : Sustainability Strategy[10]

Sustainability is not an option but a business imperative for Infosys. They have always followed a sustainable approach to business and have helped their customers conduct their business in a sustainable manner. Infosys considers sustainable practices as an opportunity to apply their core strengths for social good, and to constantly innovate to create winning solutions. They believe that growth is inextricably linked to the well-being of their ecosystem comprising employees, business partners, local communities and the environment. The sustainability policy for Infosys which was developed in the year 2009 and implemented in 2010, acts as a guide for their sustainability actions.

Strong corporate governance is a cornerstone to the policy — focused on providing business value while enhancing the long-term competitive advantage of the company and ensuring results on the triple-bottom line. Their sustainability agenda focuses on three themes — Social contract, Resource intensity and Green innovation.

Social contract Enterprises have an extended set of stakeholders today — local communities, social organizations and society. These stakeholders have the potential to influence the future of business. These stakeholders have ethical, social and environmental expectations that extend beyond financial goals and legal requirements. Infosys believe that these social covenants are fundamental to nurturing stakeholder trust and ensuring business continuity and form the basis of their contract with society.

Resource intensity In the face of accelerated depletion of natural resources, incremental increases in resource efficiencies are not sufficient, and beyond a point optimization gets prohibitively expensive. Resource intensity is about doing far more with far less. Infosys constantly looks at transformational ways to de-intensify and achieve the same or better outcomes, using fewer resources.

Green innovation Business imperatives such as environmental sustenance and resource conservation are providing new opportunities for enterprises to innovate and spur business growth. Green innovation for Infosys is about addressing sustainability challenges through innovation, differentiation, driving efficiencies an d creating new avenues for growth for their stakeholders.

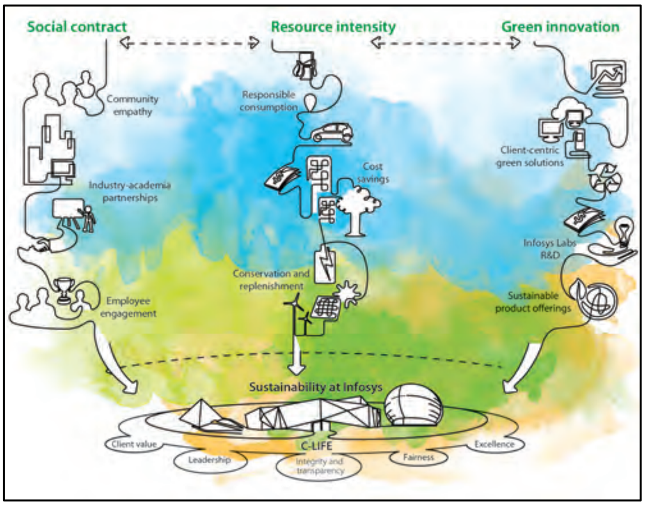


Figure 2.3 : Infosys Sustainability Strategy

[10] www.infosys.com/sustainability/pages/index.aspx

2.1.6 Establish Green Procurement Practices

A green procurement policy will help establish the commitment the organization has towards energy efficiency. The message that the organization is committed to energy efficiency will influence its supply chain and therefore cast a wider net.

2.1.6.1 Choice of Procurement Policies

There are several different types of procurement strategies which are viable to encourage energy efficiency – some product based and some services based:

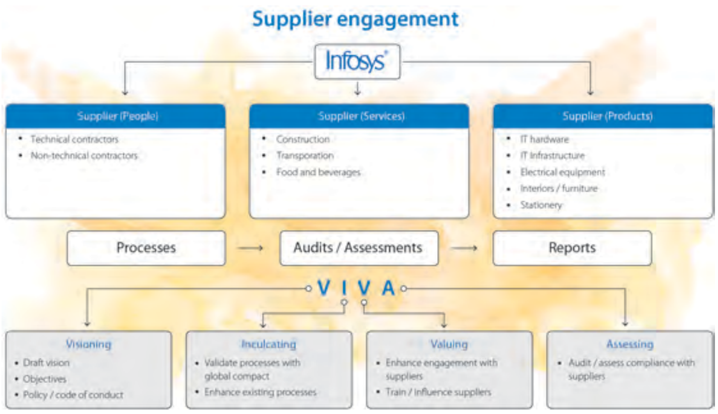
- Life Cycle Cost Analysis
- Output Based Procurement
- Marketplace
- Energy Use Warranties
- Performance Based Warranties
- Energy Supply Contracting
- Energy Service Companies

2.1.6.2 Green Technical Specifications

There are a great many technical specification catalogs from different geographical regions which may provide some initial guidance in procuring green products. These catalogs can provide a basis to include in an organization's procurement strategy. Details and some specific sites where details are available on Green Procurement is provided in the Procurement Toolset.

2.1.6.3 Case Study – INFOSYS : Green Procurement

If the targets sound extreme, the means of reaching them can be truly radical. For example, explains Rohan Parikh (Head of Infrastructure and Green Initiatives) , the company has moved to performance-based contracts, effectively forcing project teams to practice integrated design by withholding fees if performance goals are not met. "We understand you're the creative guys," Parikh says he told prospective architects of its most recently completed building, SDB1, "but the only way you're going to work with us is if 80% of the floor space is day lit and the solar heat gain is limited to 1 W/ft2." The real kicker? You lose 25% of your fee if any building occupant requests a window blind. Because architects, engineers, and owners worked so closely together, the performance goals were met, he says, and SDB1 has become the company's model for its next generation of campuses.



Focus area	**Status 2012-13**	**Status so far / Way forward**	**Goals 2013-14**
Suppliers			
Supply chain	Have trained 30% of suppliers on Responsible Supply Chain practices. Have not been able to audit 10% of suppliers on their Responsible Supply Chain practices.	Will train 25% of suppliers on Responsible Supply Chain practices. Will audit 10% of suppliers on their Responsible Supply Chain practices.	Will strengthen supply chain processes to capture sustainability-related information. Will establish a process to audit critical suppliers on an ongoing basis.

Key stakeholders	**Engagement mode and frequency**	**Internal departments**
Vendors / Alliance partners	Partner meets (1) Procurement policy and vendor selection process (1) and (7) Event brochures (7) Vendor satisfaction surveys (1) Vendor review meetings and awareness sessions (1)	Purchase Personnel Computers and Communications Division Facilities
Local community	Site visits (6) and (7) Interviews with local NGOs and community representatives (6) and (7) Sustainability portal on website, *www.infosys.com* (1) Meetings with associations / NGOs (6) and (7) Local community meetings (6) and (7) Press releases (2) and (7) Social media (6) and (7) Website, *www.infosys.com* (7)	Education & Research Infosys Foundation Corporate Marketing

(1) Annual	*(2)* Quarterly	*(3)* Monthly	*(4)* Trigger-based	*(5)* Regulatory compliance-based	*(6)* Targeted	*(7)* Need-based communication

2.1.7 Establish Energy Goals – BHAG & On The Way

Energy goals and targets are essential. If they are quantitative and well defined, then metrics for success are more likely to be met or beaten. They also establish an internal benchmark for the energy team to gear up for. If there is no goal, the result can and will be weak.

At the highest level there are two levels of goals which can be considered :

- Top Down - BHAG[11] : "Big Hairy Audacious Goal"

[11] Built to Last: Successful Habits of Visionary Companies, Jim Collins and Jerry Porras (1994)

- Bottom Up - On The Way : Near Term and Mid Term Goals

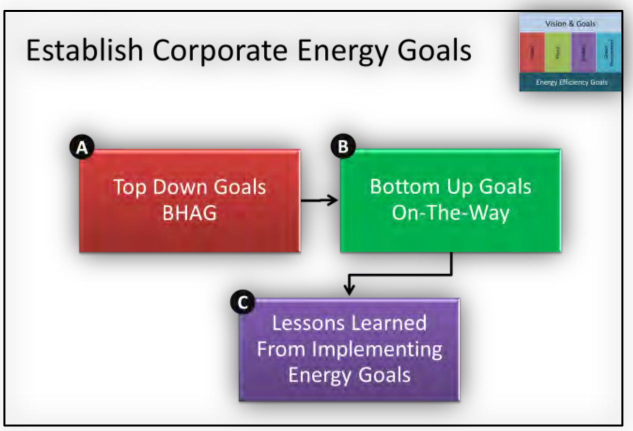


Figure 2.4 : Establish Corporate Energy Goals : BHAG & On-The-Way

2.1.7.1 Top Down Goals – BHAG

Is an "audacious 10 to 30 year goal on the progress that an organization has toward an envisioned future. A BHAG is clear and compelling, it catalyzes team spirit and serves as a rallying and focal point for effort. It is unambiguous in its definition and has a clear, well defined finish line.

An organization which is serious about reducing its energy use and carbon footprint will need to think "out of the box" and has been described by Infosys as "have unreasonable goals". The idea is to be **bold** and **aggressive** – the goals may appear to be unreachable and not achievable, but unless one pushes the limits, it will never be achieved. This will set the stage for the whole organization totally around the corporate goal (blessed and endorsed by executive commitment) of improved energy efficiency, reduced energy use, lower carbon emission and very likely (as a result) improved bottom-line.

BHAGs force managers to look outside beyond their "tunnel vision" of their own departments or operations. The aggressiveness of the BHAGs means that energy teams and facilities teams will not be able reach the goals without "touching the process," looking at all resources, all technologies, and operational aspects. This has helped make "thinking outside the energy box" an accepted norm.

Many corporations and organizations around the world are adopting BHAGs in relation to their energy plans and strategies. These are all measurable, public goals which put teeth into commitment. Common examples of BHAGs could include

- Reduce Overall Energy Consumption Across the Organization by 40 % in the next 10 years
- Decrease Natural Gas usage to baseline levels of the year 2000
- Reduce Electric Usage by 25 % over the next 5 years

2.1.7.2 Case Study – Pepsico, DuPont, California Public Utilities Commission : BHAG

PepsiCo - Set BHAGs top-down, not bottom-up, intentionally to force out-of-box thinking:

- Electricity—20 percent
- Fuel—25 percent

- Water—20 percent

The results far exceeded the goals, saving 30% on water and 45% on energy, by rethinking the whole process.

Dupont - In 1999, Dupont announced publicly that they would achieve the following by 2010

- Hold total energy use flat versus a 1990 baseline
- Reduce GHG emissions by 65% versus 1990 (achieved in 2004)
- Supply 10% of total energy from renewable resources

They have not only achieved these goals but have since committed to reduce GHG emissions an additional 15% versus a 2004 baseline by 2015.

California Public Utilities Commission (CPUC)[12] **-**In 2008, the CPUC established a few BHAGs of its own

- By 2020, all new residential construction in California will be zero net energy (ZNE).
- By 2030, all new commercial construction will meet the same goal.

2.1.7.3 Bottom Up Goals - On The Way : Near Term and Mid Term Goals

These energy goals are more tactical and can be incremental, in smaller steps and will slowly add up towards the BHAG. They can also be specific to a given part of the building system – for example the HVAC system, Electrical, Lighting and so on. The approach and steps to achieve these goals, the resources required, the financial analysis and RoI's, the teams and skills needed all should be defined and implemented. These should be highly achievable and be SMART

- Specific
- Measureable
- Achievable
- Realistic
- Timely

Examples could include :

- Improve energy efficiency of operations 2.5% year-over-year for the next 5 years
- Reduce greenhouse gas (GHG) emissions per employee by 2%
- Improve Chiller Efficiency by 5 % every year for 3 years
- Reduce the EUI (Energy Use Index) from 100 KWh/m^2 to 70 KWh/m^2 of floor area
- Improve our Energy Use per employee (EUE) by 5 % every year for the next 5 years
- Reduce Lighting Costs by 3 % every year for the next 5 years
- Have all new buildings to be have a high performance certification (for example LEED Platinum Certified effective 2015).
- Have annual energy audits to measure year on year energy use improvements
- Develop a Life Cycle Cost Analysis (LCCA) for new energy improvements / retrofit projects

[12] http://blog.rmi.org/zero_net_energy_2.0 . ZNE was defined as a project that "employs a combination of energy efficiency design features, efficient appliances, clean distributed generation, and advanced energy management systems to result in no net purchases of energy from the grid

2.1.7.4 Lessons learned from Implementing Energy driven Goals [13,14]

Key lessons learned from energy efficiency successes as a result of implementing energy goals include:

- Setting challenging goals as a rallying point is important. It's okay if the path / method to achieve these goals is not clear. In fact, if one knows exactly how to get there, it probably means that the bar set for the goal is not high enough.
- Audacious energy efficiency goals can often impact progress and improvements in other areas of the business. Setting stretch goals on energy, forces company staff to "think outside the energy box," and can lead to improvements in other processes, quality and a better understanding of linkages between energy and other aspects of the business.
- BHAGs cause the investment in energy conservation projects to be seen in a different light compared to other normal business investments. Longer project life and more reliable long-term savings will likely result in longer returns on capital.

2.1.7.5 Case Study – INFOSYS : Energy Goals

"It had to be unreasonable; it had to be a paradigm shift," says Rohan Parikh, Infosys Head of Infrastructure and Green Initiatives, of the company's green building goals. He calls the method "disruptive design" and describes the results as "an extreme conversion process" involving "design first, education second." The goals include LEED Platinum certification as a minimum standard for all buildings, 50% reduced energy consumption, 50 % reduction in carbon footprint, 100% renewable energy, and net-negative water consumption by 2018.

Strategic goals

Sustainability is a continuous process for us, and we monitor our progress on our stated goals at regular intervals. The following table illustrates our work in implementing our strategic sustainability goals, and what we plan to do in the immediate future:

Focus area	Status 2012-13	Status so far / Way forward	Goals 2013-14
We will build frameworks to integrate our business and sustainability goals	• We have aligned our human rights policy to the UNGC principles. • As part of our Responsible Supply Chain initiatives, we have started engaging our supply chain contractual staff through training and capacity-building on various topics, including their rights at the workplace, health and safety, financial tips, and behavioral competencies. • Our Executive Co-Chairman, S. Gopalakrishnan, has been appointed as the new President of the CII. This will help us strengthen the larger ecosystem. • We became the first Indian IT company to trade on the NYSE Euronext London. This is a significant step taken towards achieving our vision of being a globally-respected corporation, enabling us to surge ahead to build tomorrow's enterprise.	• We have made our Carbon Goals public and have drawn up a roadmap to achieve them by fiscal 2017. • Our sustainability goals have been integrated into the Corporate Scorecard of the Company. • Our Sustainability Policy has been created and rolled out. • The procurement policy covering green procurement and human rights aspects is being deployed at our India-based locations. • We will continue to strengthen the organization as a platform for employee engagement on sustainability actions across environment and society.	• Integrate sustainability parameters with our business excellence model – the Infosys Scaling Outstanding Performance (iSOP) framework.

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[13] Pew Energy Efficiency Report, http://www.c2es.org/docUploads/PEW_EnergyEfficiency_FullReport.pdf

[14] http://www.c2es.org/docUploads/PEW_EnergyEfficiency_PespsiCo.pdf

Operational goals

The following table gives a break-up of our goals in the areas that we consider critically important in our sustainability journey :

Focus area	Status 2012-13	Status so far / Way forward	Goals 2013-14
Environment			
Carbon	• 14.86% (Scope 1 and Scope 2 emissions) reduction in per capita since 2011-12	• 53.53% (Scope 1 and Scope 2 emissions) reduction in per capita since 2007-08	• We will reduce our per capita carbon intensity by 5% over our fiscal 2013 levels.
Electricity [1] consumption	• 10.71% reduction in per capita compared to 2011-12.	• 39.9% reduction in per capita since 2007-08	• We will reduce our per capita electricity intensity by 5% over our fiscal 2013 levels.
Renewable energy [1]	• The share of renewable energy in our total electricity consumption has increased from 17.9% to 22.1% this year.	• 58 million units (22% of our total electricity consumption) of renewable energy were used this fiscal	• We will increase the share of our renewable energy by 5% over our fiscal 2013 levels, in our total electricity consumption.
Water	• We have reduced our per capita per month fresh water consumption by 14.28% over our fiscal 2012 levels.	• 34% reduction in per capita per month fresh water consumption since 2007-08	• We will reduce our per capita freshwater consumption by 5% over our fiscal 2013 levels. • We will sequester more fresh water in the ground than we consume in fiscal 2014, through rainwater harvesting strategies. • 100% of the waste water will be recycled and reused on our campuses.
Solid waste recycling	• A biogas plant at our Mysore campus and an in-vessel composting system for handling organic waste generated at our Thiruvananthapuram campus are already in operation. Currently, work is in progress on setting up a biogas plant at our Pune campus and an organic waste converter at our Bangalore campus.	• We will implement organic waste recycling plants at two of our India campuses.	• We will ensure the segregation of waste at source, at all of our campuses. • 25% of organic waste will be treated onsite, through composting or at biogas plants. • Our focus will be on minimizing waste going to landfills. • At all our construction sites, we will follow the Green Rating for Integrated Habitat Assessment (GRIHA) standards for construction waste management.

[1] New goals for fiscal 2014

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2.1.8 Presenting Results to Executive Management

After developing a Vision, Policy, Strategy, Procurement and Energy Goals for the corporation, it is critical to return to the executive management team which originally agreed to get this program kicked off and report on the progress in detail across all the segments.

In the event the executive team recommends some changes or constructive suggestions, there will need to be some re-work performed. If the executive team is reasonably happy, it will likely provide approval to graduate to the next stage of the Energy Efficiency Journey - Planning.

2.2 Planning

1. Steps for Planning Stage	4.Energy Efficiency Measures (EEM)
2. Document "State of Energy Efficiency"	5. Prioritize EEMs – Value, Cost & Complexity
3. Establish Energy Benchmarks, Baselines & Audits	

2.2.1 Steps for the Planning Stage

With a solid foundation, energy goals and executive commitment, the next steps of the energy efficiency program is the detailed "**planning**" stage.

1. Establish a Core Energy Team
2. Collect information, determine the "state of energy efficiency" for the building
3. Establish an energy benchmark, conduct energy audits and create an energy baseline
4. Determine what potential Energy Efficiency Measures (EEMs) could be undertaken and understand what the Value vs. Cost vs. Complexity of such EEMs would be.
5. Use the above information in a concise and meaningful manner to construct a solid business case for the executive management.

The business case is a very important component and needs to have some detailed discussion is therefore presented in a separate section.

All of the above of course would need to have executive management support very similar to Stage 1 (Vision and Goal.) Such an approach should be conducted on an annual basis.

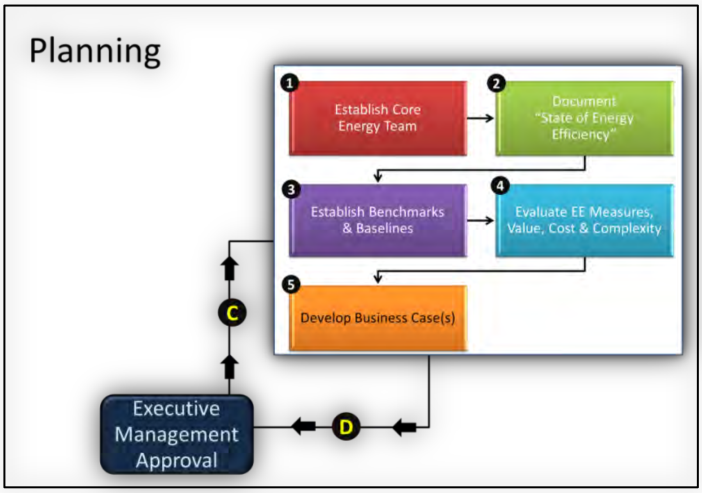

Figure 3.1 : Individual Steps in the Planning Stage

2.2.2 Establish Core Energy Team

There is no single model for an Energy Management Team which "works for all cases". How it works will depend upon the characteristics of the particular organization. It is clear however that there is clearly need for an Energy Team to successfully implement the Energy Policy and Strategy and achieve the energy savings goals. Creating an energy team helps to integrate energy management. In addition to planning and implementing specific and targeted improvements, the team measures and tracks energy performance and communicates with management, employees and other stakeholders.

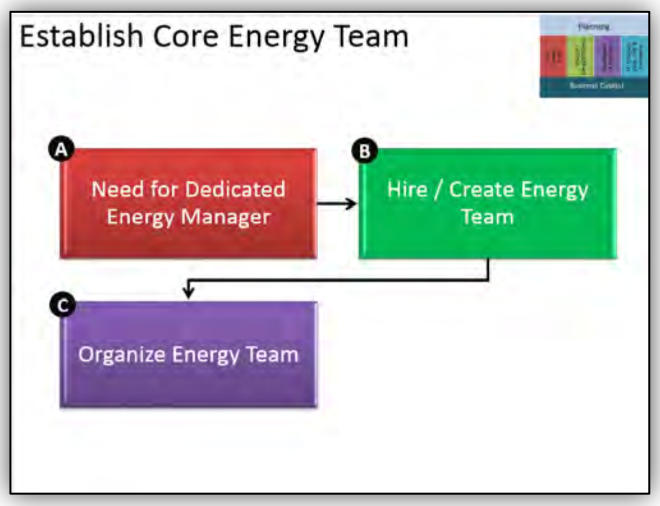

Figure 3.2 : Establishing a Core Energy Team

- Encourages greater ownership of the assessment process by influential personnel;
- Involves management (at site or corporate level) who may not be able to be involved in the detailed aspects of the assessment;
- Provides a forum for assessment review as it progresses;
- Shares the workload;
- Helps develop strategies that can be integrated into ongoing business objectives in the long term.

It is recognized that in some cases, a full energy team may not fit well into a company's finances, especially in more developed and high income countries. One option is to perhaps have a small team of 2 – 3 individuals and then supplement with a team of contractors.

2.2.2.1 Need for Dedicated Energy Manager

Some organizations may already have a dedicated Energy Manager as a standard position in the company. Others may have someone fulfilling the role, but as part of their other job duties, such as a facilities manager. Larger multi-site organizations or those with very high energy use can benefit from having a full-time Energy Manager. For smaller companies, this might be a part-time role, for example 'Energy Champions' could be appointed, giving people responsibility for energy management in addition to their existing duties.

The energy management role typically calls for a person with multi-faceted skills in communications, financial administration, information systems, as well as an understanding of technology. Staff who deal with energy management activities need a wide of range of technical, financial, personnel and training skills. Without these they are unlikely to be effective. The key is to get the right mix of skills and experience.

The energy manager is the person who will facilitate the organization’s transition to an energy aware business. Ideally, the energy manager’s position in the corporate hierarchy should align with the organization’s conventional management structure. This will enable the energy manager to network across the organization seamlessly.

The functional skills required for an effective energy manager can be categorized under the following six key areas:

- Project Planning and Management
- Communication Planning and Implementation
- Understanding Energy Use
- Identifying Potential Opportunities
- Decision Making
- Monitoring and Investigation.

The energy manager must be able to:

- Assign responsibility to appropriate decision-makers in each department of the organization for implementing energy conservation measures;
- Coordinate the different energy management activities and report on a regular basis as to the progress of each department in terms of energy efficiency and savings.
- Clear lines of reporting and accountability with energy users.
- Clear lines of reporting and accountability with senior managers.
- Assemble an inter-departmental committee to manage the energy situation.

2.2.2.2 Hire / Create Energy Team

An Energy Manager, however formidable and qualified cannot do the job by himself / herself. There needs to be a full complement of a supporting team from across the organization. A possible illustration is provided in Figure 4.3[15]. This team, (also known as the Energy Team) led by the Energy Manager, is the core group which carries the responsibility to develop and implement the energy strategy across the organization consistent to the energy policy’s objectives. The scale of activity should of course be appropriate to the size and nature of the organization.

The Energy Team, as a whole, should :

- Use energy metering, monitoring and analysis tools to measure, analyze and report energy use and energy cost
- Benchmark building energy performance, identifying exceptions and instigating corrective actions.
- Communicate with employees to be energy aware and play their part
- Provide support and advice to staff and employees

[15] US EPA : Teaming Up to Save Energy

- Identify and implement energy savings opportunities
- Keeping abreast of and manage regulatory requirements, new technical developments and potential sources of external funding for energy efficiency investments.
- Specify energy efficient features in maintenance operations, plant replacements, building refurbishments and in new builds.
- Work with procurement to ensure equipment purchases and vendor / supplier selection from an energy efficiency perspective.

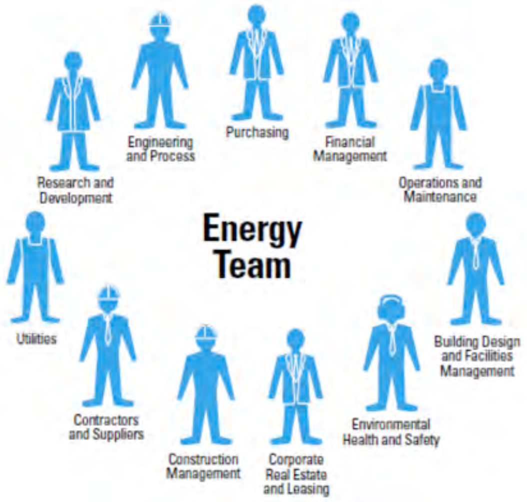

Figure 3.3 : Possible Energy Team Structure

The size of the energy team will vary depending on the size of the organization. In addition to the Energy Director who leads the team and possible dedicated energy staff, consider including a representative from each operational area that significantly affects energy use, such as:

- **Engineering, Building & Facilities Management** who have detailed experience and knowledge of plant, equipment and operational issues, as well as insights into why certain priorities or procedures have evolved
- **Purchasing & Procurement** who can advise on the financial and supply risks and opportunities associated with energy supply contracts.
- **Finance** who can assist in developing proposals so that they are suitable for consideration by management, and who may identify mechanisms (such as tax arrangements and financing options) that facilitate implementation – they may also help clarify and overcome internal and external financial barriers to action, such as separation of capital and operating budgets, tax and contractual issues
- **Operations and Maintenance** who are familiar with the day-to-day issues involved in the present operation, so that they can help identify problems and opportunities
- **Contractors and Suppliers** who are likely to be familiar with the detail of on-site issues and who, through their use or knowledge of equipment, may have ideas about how practices can save energy and bring other benefits;
- **Marketing staff** who can provide input on the importance of various product attributes, assist with presentation of proposals to management and other staff, and provide advice on building relationships, organisational and behavioural change, effective communication, and raising the profile of energy efficiency
- **Management** - who have the capacity to approve implementation, a good understanding of the business, often extensive experience in the industry, and encourage cooperation and adopt a 'whole-of-business' perspective from staff.

2.2.2.3 Organize the Energy Team

Job	Functional Role
Energy Director / Manager	• Able to work with all staff levels from maintenance to engineers to financial officers to the CXO suite. • Typically, a senior level person empowered by the top management

Job	Functional Role
Senior Management	• Energy Director reports to the Senior Management Council or a Senior Executive – could be the CEO. • Council or executive provides guidance and support to Energy Director.
Energy Team	• Members form a cross-functional team from operational business units or departments such as engineering, facilities, finance, procurement. • Include support functions such as IT, Human Resources, Public Relations
Facilities Team	• Facility managers, electrical personnel • Two-way information flow on goals and opportunities • Facility-based energy teams with technical person as site champion
Energy Team Structure	• Separate division and/or centralized leadership • Integrated into organization's structure and networks established
Resources & Responsibilities	• Energy projects incorporated into normal budget cycle as line item • Energy director empowered to make decisions on projects impacting energy use • Energy team members have dedicated time for the energy program
Third Parties	• Consultants, vendors, customers, and joint venture partners • Energy Savings passed through lower prices for products & services

2.2.2.4 Case Study – INFOSYS : Core Energy Team

INFOSYS – Early Green Initiatives Core Team

- **Head – Green Initiatives**. Was responsible for driving the team and constantly discussing with the management and updating them of the team's activities on a regular basis (up to twice a week)
- **Green Initiatives Lead.** Responsible for HVAC system design in new buildings and for driving energy audits in existing buildings. Reviewing the design submitted by consultants. Questioning all assumptions, ensuring no rule of thumb data is used, redefining standards used. Got 2 different companies to conduct energy audits across all 44 chiller plants in India.
- **Green Initiatives Team Member**. Came from a hardcore energy audit background and experience. Responsible for energy metering across campuses and for supervising audits. Studying energy use patterns in buildings starting with 1 campus. Also responsible for identifying portable instruments like power meter, water flow meter, thermal imager, lux meters (lighting) which were used for conducting basic checks and audits internally.
- **Green Initiatives Team Member**. Responsible for lighting design for new projects and for lighting audits and retrofits in old buildings. Both came from specialization in lighting technologies and joined as interns (final year of their Master's degree) and later became employees
- **Green Initiatives Team Member**. Also joined as an intern (Bachelor's degree in environmental engineering). Was responsible for studying water consumption and in design of new technologies for water and waste water treatment. Efforts on water started a bit later compared to energy.

INFOSYS – Current Energy Team

- **Total # of Team Members**
  - Started as a 5 member team and now expanded to 25
- **Skills / Educational Qualification of Team Members**
  - Most of the members are with an MS (Engineering) with a specialization such as energy efficiency, water efficiency and waste management.
- **Team Structure / Specialization**
  - It was driven by the opportunities existing in different areas of building design and operations.
  - The largest energy consumer in the Infosys campuses was HVAC systems, and therefore this area has the highest number of specialists – from design and execution to retrofits and innovative projects, including smart building systems.
  - This was followed by building design where focused efforts were required to bring in an integrated approach.
  - This was followed by focus on water efficiency, waste management, and biodiversity, to develop an integrated approach to sustainable development.
- **Challenges / Barriers / Successes**
  - The main challenge was to convince senior team members and established consultants in the starting phase as they had an old school of thought, which was difficult to change.
  - When every assumption was literally questioned and studied, and standards being followed in the designs, things began falling in place, and logic always won over "rule of thumb".
  - Once the numbers to prove the impact were available, the intervention of the team in all designs was more welcome and starting being seen as beneficial

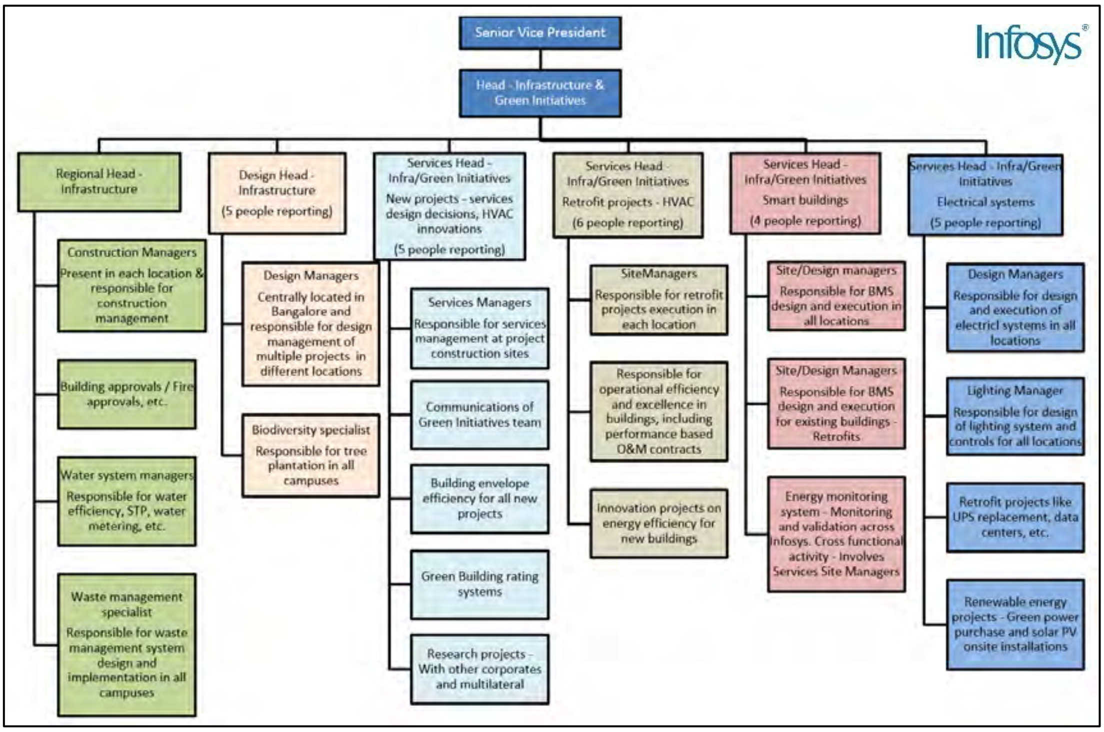

Figure 3.4 Infosys Team Structure – Roles & Responsibilities

2.2.3 Document "State of Energy Efficiency"

It is essential to get a firm handle on the current energy efficiency status in the building portfolio. Similar to the concept of a "State of the Union" or "State of the Company" there needs to be a "State of the Energy Efficiency" for the building. This is essentially a profile of the building and the different parameters which could impact the energy equation for that building.

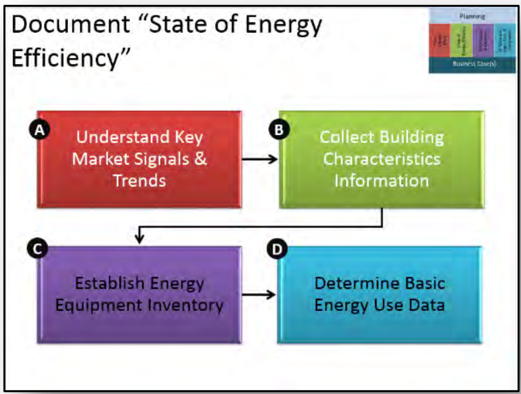

Figure 3.5 : Documenting the "State of Energy Efficiency" for the Corporation

The following components will make up such a building profile

- A broad understanding of the key market signals and trends in the area of building energy efficiency.
- Documenting the ecosystem and the role / importance it plays in the energy landscape.
- A reasonably detailed overview of the physical characteristics of the building of the building and operating schedules.
- A detailed list of all mechanical, electrical and IT equipment which use energy
- Energy usage data and metrics including utility bills, including electricity, heating and cooling, for the past two years

On a regular basis (perhaps annually), this profile or portfolio needs to be updated, to make sure that all the information is current. The first time this "state of building portfolio" is created, it will be time consuming and will require the participation of different disciplines across the company. However, the periodic updates will only be incremental in nature and therefore be less effort.

There are many software packages available today which provide a comprehensive end to end solution merging asset management and energy management, but ensuring that the right data is provided and available is the key aspect which must be addressed.

2.2.3.1 Understand Key Market Signals and Trends

It is essential to understand the lay of the land regarding building efficiency including but not limited to government regulations, incentives, policies, enforcement, common energy efficiency practices, industry trends, drivers for energy efficiency programs, and finally barriers to energy efficiency.

All of the above aspects will play a role in implementing a robust and successful energy efficiency plan and therefore some upfront analysis and planning in this regard is critical. Some early and high level indicators can be found in the literature or market research such as the survey conducted by the Institute for Building Efficiency (www.institutebe.com)

What is the role of Government, Regulations, Policies & Incentives

This is very important aspect to consider while laying out the plans for an energy efficiency program. The government and its role in energy efficiency can play a pivotal role in your plans. For example, many countries have steep rebates and incentives for the use of renewable energy such as Solar PV for on site power co-generation. If economically viable, one may want to consider such an option as part of the planning process.

Examples of areas to look for / questions to ask and document might include :

- Is there a requirement for all new buildings, as well as buildings undergoing renovation, to be covered by energy codes and meet minimum energy performance standards (MEPS) such as LEED or BREEAM or equivalent.
- Does a mandatory Energy-Use Disclosure law exist or in the near future – if so, what are the descriptors and boundary conditions ?
- What government support or incentives exists towards “net-zero” or “low energy” consumption buildings (do these initiatives make the building more economically viable)
- Does a Carbon Emission Tax scheme exist or planned ? – if so, what are the descriptors and boundary conditions
- Are tax credits, incentives and rebates along with low interest financing available for energy efficiency improvement projects.
- Is there a package of government policies to improve the energy efficiency of existing buildings, with emphasis on significant improvements to building envelopes and systems during renovations.
- What kind of government assistance in relation to energy audits, energy ratings and certification schemes (similar to the schema in Singapore where energy audits are cost shared @ 50 % by the government up to a specific $ limit).
- Is there government assisted or subsidized training and other measures available for building designers, owners and others to improve the quality and reliability of building design and operation including retrofit services.
- Does the government have a policy of “building energy labels or certificates” similar to that found in appliances – such as an “Energy Star” for Buildings.
- What (if any) are the government policies to improve the energy efficiency performance of critical building components, such as windows and heating, ventilating and cooling (HVAC) systems.
- What energy efficient technologies are being recommended over others by the government (Compact fluorescents over incandescent lighting for example)
- What international test standards and measurement protocols to enable performance comparisons and benchmarking exist in the market.

Appropriate action items related to the above list will need to be addressed and taken into consideration at the time of implementing specific energy conservation measures. While studying these aspects, it is important to look at the current status, what is coming soon or on the drawing board and what is unlikely to come over the next 3 years. A regular update of this in a 6 monthly timetable will keep the information current.

Study the Drivers & Barriers for Energy Efficiency

A clear understanding of what potential driver and barriers in the marketplace are will help in the development of a robust energy action plan. Not all drivers or barriers will apply at a given period of time and new ones may crop up from time to time. A preliminary list of common driver and barriers is given below.

Possible Drivers	Potential Barriers
• **Energy Cost Savings**	• Lack of Awareness – of Energy as an issue and / or Technologies
• **Government Incentives / Rebates**	• Lack of Technical Expertise
• **Enhanced Brand / Public Image**	• Uncertainty of Savings from Energy Retrofits
• **Increased Energy Security**	• Lack of Funding – OPEX and/or CAPEX
• **Greenhouse gas emissions**	• Insufficient Payback / RoI
• **Existing Policies**	• No Organizational Ownership
• **Increasing Asset Value**	• Lack of Split incentives – due to Tenancy / Landlord situation

Common Energy Efficiency & Management Practices

The next aspects to consider is to determine what energy efficiency / management practices are being implemented in comparable or peer buildings or companies. This is normally a good indicator of what is “low hanging fruit” and what was cost effective and worked for another similar entity. If it worked for them, unless some of the specifics are very different, there is a strong likelihood that it will apply to other organizations.

Examples of what type of conservation measures to look for include :

- Lighting Retrofits
- HVAC & Controls Retrofits
- Water Efficiency Measures
- Running Energy Focused User Behavior Programs
- Onsite Renewable Energy Implementation
- Building Envelope Improvements
- Installing Smart Building Technologies
- Retro-commissioning or System Tune ups
- Energy Demand Management

Other Peer Activities

For similar reasons, in addition to studying the energy efficiency and management measures of peer companies or buildings, it is also important to see what kind of programs that have been implemented or being conducted.

- Tracking & Analysis of Data
- Measurement & Verification of Energy Savings
- Energy Audits
- Action Plan to Implement Projects

- Communicating Energy Policies & Goals
- Benchmarking energy consumption
- Dedicated Capital Budget
- Dedicated Energy Staff
- Sustainability Reporting

2.2.3.2 Collect Building Characteristics Information

The next stage is to establish the physical characteristics of the building (or portfolio of buildings as the case may be). Take pictures as needed for better description. Place these characteristics into categories for example :

1. Site and Building Information
2. Functional Information
3. Details on Areas (size)
4. Operational Information / Scheduling

This information can be captured and stored in some searchable, replicable fashion for example a spreadsheet or simple database. While this information is good "snapshot" of the building, its characteristics, use and energy profile, it will be the starting point for the next stage of benchmarking and performing energy audits. The more detailed and accurate the information collected, the better it will be.

As with all data collection, the first time will be the most time consuming and also needs to be verified / validated for accuracy. Regular interim updates will be incremental in nature and therefore quicker to complete.

Some of this information maybe already available, stored in different documents, databases or information systems but needs to be collated under a single category for reasons of efficiency. If there is an ERP (Enterprise Resource Planning) software which has this information already, it may be an easier exercise with the help of IT to develop a new database. Information lacking, may need to be added. The advantage of doing this is that a tie into the utility billing (Financial) or Equipment (Inventory) will likely be done via an ERP system.

2.2.3.3 Establish Energy Equipment Inventory

While this topic maybe considered to be part of an Energy Audit, sometimes it is better to get this information in a pre-audit stage. It will provide an overview of the scale and different types of energy equipment along with their key functions / use. Such information is very important in any form of energy planning exercise since it helps to decide which to focus on, how large the problem maybe and any implications for large scale implementation of an energy savings measure.

The following is a list of commonly found energy equipment in most commercial buildings, but is not a comprehensive list. Specifics / any variant will need to be addressed during the physical count.

- HVAC
- Hot Water
- Office Equipment & Plug Loads
- Lighting
- Elevators & Escalators

2.2.3.4 Determine Basic Energy-Use Data

This will round out all the basic information about the building and its equipment and inventory. Since the bottom line is “energy”, getting a basic handle on the core energy information for the building / building portfolio will be important. In many cases, all of thi information may or may not be available and if so, it should be documented, so that appropriate sub-metering can be installed. Such activity can be one of the early recommendations from the formal Energy Audit.

- Categorize current energy use by fuel type, operating division, facility, product line, etc.
- Identify high performing facilities for recognition and replicable practices.
- Prioritize poor performing facilities for immediate improvement.
- Understand the contribution of energy expenditures to operating costs.
- Develop a historical perspective and context for future actions and decisions.
- Establish reference points for measuring and rewarding good performance.
- At a minimum, collect data by fuel type at an individual building or facility level
- Collect data from sub-meters, if possible
- Use actual, not estimated, use data, if possible
- Use data that is current and timely
- Use tracking systems to develop quarterly and annual reports that profile energy performance
- Use tracking systems to allow facilities to compare their performance to their peers
- Use a tracking system to organize data and benchmark against industry benchmarks

While the following information is recommended for data collection – however it must be recognized that it can be an expensive proposition to collect detailed data especially since there may be many buildings, multiple sites and multiple geographies. In future, new meters may have more improved capabilities, making data collection easier.

Overall Energy Information

- Overall Energy Bill
- Overall Electric Energy Usage – By Month or Year
- Overall Natural Gas Energy Usage – By Month or Year
- Overall Cogeneration Energy Usage – By Month or Year
- Renewable Energy Sources - Details

Indoor Energy Use & Cost

- Lighting
- HVAC
- Hot Water
- Refrigeration
- Plug Load
- Average Plug Load Density

Data Center

- Data Center PUE
- Data Center Cooling Source

Outdoor Energy Use & Cost

- Parking Lighting
- Walkway Lighting
- Signage Lighting
- Landscape

2.2.3.5 Case Study – INFOSYS : State of Energy Efficiency

INFOSYS – State of Energy Efficiency

- Infosys with its HQ in Bangalore, India, has 71 offices and 93 development centers in United States, India, China, Australia, Japan, Middle East, and Europe. It has more than 29 million sq. ft. of buildings globally, as of FY 13.
- All the buildings built after 2007 are green buildings and most of them are LEED platinum/ GRIHA (the Indian building rating schema) five star rated buildings. All the new buildings have low Energy performance Index due to efficient building design.
- This has been achievable through right building orientation, efficient building envelope, highly efficient equipment, lighting, heating and cooling systems, maximum daylight utilization, using green innovative technologies, for example, energy harvesting wireless sensors, and more importantly monitoring our energy consumption at a granular level, which will help us remove wastage and reduce consumption.
- In 2013, the per capita energy consumption has come down by 40%, with 178 units per person from the 2008 levels of 297 units.

2.2.4 Establish Energy Benchmarks, Conduct Audits & Create a Baseline

In the discussion so far, a lot of the information collected about the building has been limited in terms of details about the energy use patterns and consumption. Building owners, managers, operators all would like to reduce the energy consumption, energy costs and also carbon footprint of their buildings. In order to achieve that goal, they ask questions such as:

- Which of the many possible energy efficiency measures (EEMs) should be implemented ?
- Which EEMs have the best chance of success ?
- Which EEMs have the best RoI on investment ?
- What is the best way to verify the savings achieved from the EEMs implemented ?
- How does my building compare to other similar buildings ? – Where do I rank ?

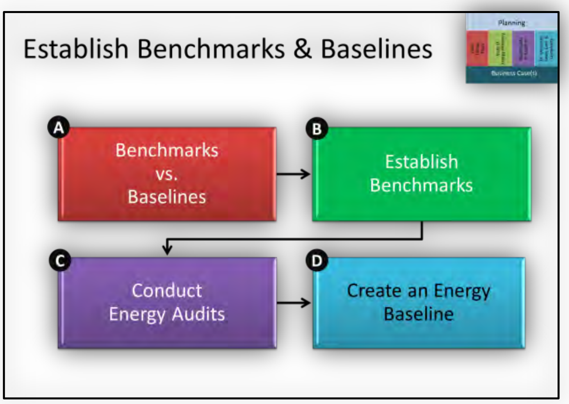

Figure 3.6: Energy Benchmarks, Audits and Baselines

One can get answers to the above types of questions and details on energy usage and building performance via the use of benchmarks, baselines based on energy audits. All three of these metric based information flows are critical to an energy plan and implementation.

It should be noted that these are quite different from the "State of Energy Efficiency" since the latter captures not only some high level energy data but also physical characteristic data about the building and its equipment. The former (benchmarks and baselines) will need to much more quantitative in nature and will typically involve deep dive audits.

2.2.4.1 Benchmark vs. Baseline

Just to make sure that the terminologies are established upfront, we shall define the 3 terms, benchmarking, baselining and audits and the relationship between these three terms.

Energy benchmarking[16] – This is the process of collecting, analyzing and relating energy performance data of comparable activities with the purpose of evaluating and comparing performance between or within entities. Entities can include processes, buildings or companies. Benchmarking may be internal between entities within a single organization, or external between separate organizational entities.

Energy baselines[17] are defined as 'quantitative references providing a basis for comparison of performance' that apply to a specific time period and provide a reference for comparison before and after the implementation of Energy improvements.

Energy Audit[18] is an inspection, survey and analysis of energy flows for energy conservation in a building, process or system to reduce the amount of energy input into the system without negatively affecting the output(s). Both benchmarking and baselining will typically use an Energy Audit as a basis for any form of quantitative and qualitative assessment.

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[16] Wikipedia, http://en.wikipedia.org/wiki/Benchmarking

[17] http://eeo.govspace.gov.au/files/2013/03/ESMG-Chapter-1.pdf

[18] http://en.wikipedia.org/wiki/Energy_audit

Benchmarking and Baselining are not a one-time exercise, but a continuous effort to continuously establish where the organization is in terms of its energy usage and efficiency as well as the impact of energy efficiency measures.

2.2.4.2 Establish Benchmarks

Benchmarking refers to the comparison of a given building's performance against another similar building or set of buildings with similar function. Benchmarking often uses fairly coarse metrics compared to baselines and uses peer buildings as a comparison. Approaches and guiding principles to energy reduction are typically broad and the EEMs identified are typically less complex with less system interdependence. Analysis is better suited for EEM evaluation when the Return on Investment (RoI) for a given set of EEMs is pretty well understood in the industry / peer buildings.

For example :

- Outside air economizers
- Installing VFDs on pumps or fans
- More efficient light fixtures
- Lighting occupancy sensors
- Daylight dimming controls
- Plug load reduction strategies (e.g. plug load strips, occupancy sensors, power management software, Building Energy Management Software (BEMS) etc.)

Internal benchmarking is an approach where an organization compares the energy use in a given building against other buildings within the organization. An example maybe a multinational corporation with multiple campuses or buildings in different locations. The results are then used (1) to compare energy performance among buildings, (2) identify which building performs the best (or worst) and why, (3) which buildings have the greatest potential for improvement, (4) get historical energy performance, (5) identify best practices and apply them to other buildings and (6) increase the ability of the organization (as a whole) to interpret and analyze energy data.

External benchmarking is an approach, where the peer buildings are typically in peer organizations (as opposed to the same organizations), whose businesses are typically in the same sector or industry. Some benchmarks can also be developed against other sectors and industries, for a higher level overview of the energy performance of facilities against some standardized performance rating. This information is typically used to

- track how an organization is performing against similar (peer) industry or sectors in terms of building performance levels
- identify new best practices to improve building energy performance
- better understanding of how to improve analysis and evaluation of energy performance,
- identify high-performing buildings for recognition such as an ASHRAE Award or Energy Star Labeling.

Benchmarking (internal and/or external) can be both qualitative as well as quantitative in in its nature. Many benchmarking projects combine quantitative and qualitative measures since it then provides a more holistic view to the energy performance question. An example of a qualitative approach is to compare different management and operational practices across a portfolio of buildings which then establish best practices or areas for improvement. In a quantitative approach, there is a numerical comparison of performance - for example, from a historical perspective (how has it changed in terms of time) as well as in an industrial context (How does the building compare to a peer group of buildings?).

Energy use intensity (EUI)

EUI is a normalized quantitative benchmarking metric. The EUI Ifor a building is calculated by taking the total energy consumed in one year (usually measured KWh) and dividing it by the total floor space of the building. For example, if a 10,000 m^2 building used 1000,000 KWh over the year, its EUI would be 100 KWh/m^2.

Source and Site Energy [19].

Site Energy measures the amount of energy consumed at a facility—which is derived from the electric, gas (debit) and renewable on-site generation (credit) such as PV. The primary advantage of this metric is that it is easy to measure and comprehend and puts the focus of efficiency at the location where building owners and operators have the most control: the building.

Source Energy includes the energy used offsite to generate and transport the energy which is consumed at the building and site energy. In Europe, "primary energy" is used in the legislation and in most countries. Advantages are that it provides a full accounting of the impacts of the energy used (environmental, resources, etc), it uncovers the "hidden" costs of energy consumed onsite. A disadvantage is that it is you have to know for each secondary energy, the primary energy coefficients by which to multiply site energy.

While the EUI is a reasonable metric, it has its own limitations. Other factors such as occupancy, definition of area, conditioned vs. non-conditioned and weather or geographical aspects all influence the EUI. For example, it does account for number of occupants in a building – which may drive the EUI up or down depending on occupant density. Sometimes a modified EUI is used - KWh/m^2/employee. Even measuring the area of a building is not necessarily straightforward for example in terms of leasing, gross vs. rentable area is a factor, but energy use is more likely influenced by whether the space is conditioned or not. Weather normalization is sometimes also an important factor since it is unfair to compare two similar buildings with radically different external environments.

2.2.4.3 Conduct Energy Audits

The main outcome of an energy audit is (1) list of recommended energy efficiency measures (EEMs), (2) their associated energy savings potential, and (3) an assessment of whether EEM installation costs are a good financial investment.

There are a number of formal standards related to energy audits for commercial buildings including (but not limited to) ASHRAE Research Project RP-669 and ASHRAE Special Project SP-56 : Procedures for Commercial Building Audits, the Natural Resources Canada Federal Building Initiatives – Audit Standard Guidelines, the European standard : NF EN 16247-1 for Energy Audits and the ISO standard FDIS 50002 (under development) : Energy audits -- Requirements with guidance for use.

Energy audits are typically conducted by energy services companies (ESCOs), energy consultants and engineering firms. This is often therefore an outsourced activity – but within the ecosystem of partners. The energy auditor leads the audit process but works closely with building owners, staff

[19] http://www.fmlink.com/article.cgi?type=Sustainability&title=Energy%20Metrics%20for%20Buildings%3A%20a%20Primer&pub=BuildingGreen&id=41768&mode=source

and other key participants throughout to ensure accuracy of data collection and appropriateness of energy efficiency recommendations.

Normally, a review of all the available data of the building characteristics and its historical energy usage including bills is conducted first, to establish some key parameter and then this is followed by an onsite inspection of the physical building.

Types of Energy Audits

There are two ways to do energy audits – a whole building approach or targeted use-specific audits. Whole building audits (building envelope, building systems, operations and maintenance procedures, and building schedules) provide the most accurate picture of energy savings opportunities at the building. However, if there specific energy efficiency retrofit projects in mind (for example lighting or heating, ventilation and air conditioning and limited funds to invest, targeting the audits to specific systems may be of value. In some cases, the energy audits should be linked with overall structural and other building stock related audits, in order to provide a more realistic picture of the impact of the different energy efficiency measures (EEMs).

The table below describes typical stages / milestones and deliverables in an energy audit.

Phase	Milestone	Activities
Preliminary review of energy use	• Facility benchmarked against similar buildings • Base energy load identified	• Collect and analyze utility data • Calculate EUI and compare to similar facilities • Assess energy efficiency improvement potential
Site assessment	• Site data collected • Immediate energy savings opportunities identified • Exit meeting held to discuss preliminary findings	• Interview building staff • Visually inspect building and key systems • Collect data
Energy and cost analysis	• EEMs prioritized according to project and financial goals • Savings estimates generated	• Evaluate utility and site data • Analyze energy and cost savings • Develop list of recommended measures
Completion of audit report	• Exit meeting held to walk through final report • Action plan for next steps	• Summarize findings • Present recommendations

The following is a list of possible items that an energy audit could cover :

Lighting	HVAC	Movement	Computing Equipment	Other Energy Use
• Installed Lighting • Plug-In Lighting • Façade Lighting • Outdoor Lighting • **Light Pipes**	• Pumps • AHU & Exhaust Fans • Chillers & Boilers • Cooling towers	• Elevator (Human) • Elevator (Goods) • Escalator	• Data Center (PUE) • Plug Load	• Refrigeration • Cooking • Dishwasher • Hot Water • Coffee

Lighting	HVAC	Movement	Computing Equipment	Other Energy Use
• **SkyDomes**	• Reheat Coils • Packaged HVAC • Chilled Water • Purchased Steam • Air Compressor • Micro and mini-cogeneration • Fuel cells • Heat pumps • VAV, VRV, DRV			machines, etc.

2.2.4.4 Create an Energy Baseline

An Energy Baseline provides a reference point for a building's performance prior to any energy retrofits or EEMs being implemented. It compares a building's performance for a given time period to another time period (for example 5 years ago to the previous year to current). Typically, baselines are very building specific and will vary from one building to another. They can provide very detailed guidance on EEMs, including capturing effects of interactions of measures on different systems (as compared to benchmarking which is at a much less granular level of detail). For example :

- Large building tenant improvement retrofits or expansions
- Aggressive energy reduction goals requiring system re-definition and re-design
- Identifying internal load and envelope measures needed to eliminate or greatly reduce active cooling (using natural ventilation, pre-cooling, etc.)
- Evaluation of new heating and cooling systems
- Combined envelope/shading strategies coupled with dimmable lighting, maximizing day-lighting.

IMPVP[20] and ASHRAE[21] Guideline 14 provide guidance that an energy baseline should be based on a mathematical model of how energy use responded to independent variables during a reference period, rather than just a measure of actual consumption during a reference period. This allows one to account for external factors such as weather, building use, occupancy or production that affects energy usage over time. As an example, energy usage in a given year compared to the next year for the same building, all else being the same may vary due to an unseasonably hot summer or cold winter. Therefore, very often energy baselines are a combination of actual energy measurement and some calculation methodology.

Information required for Baseline

An energy baseline is a representation of a building's energy usage pattern in its current state, using either a calibrated energy simulation model or measured energy data (or a combination thereof). Most of the core information required for the energy baseline would have been collected in the

[20] International Performance Measurement and Verification Protocol (IPMVP), http://www.evo-world.org

[21] American Society for Heating, Refrigerating and Air-Conditioning Engineers, www.ashrae.org

activity of establishing a “State of Energy Efficiency” for the building such as building characteristics, HVAC and energy equipment specifications, operations data and measured energy end use data. When put together, all the compiled data provide a powerful tool to identify, prioritize, and verify a wide array of potential EEMs.

Skills Needed for Baselining

Common energy simulation tools such as EnergyPLUS, IES, VisualDoE are available and appropriate training for the use of those software tool is necessary. A good building energy modeler and/or energy analyst is essential for this task. Measurement is done with the use of sensors and sub-meters, which also requires specific skill sets such as knowledge of mechanical, electrical, wireless technologies and installation techniques. Therefore it is important to ensure that these skill sets are available within the ecosystem – either in the form of an employee / energy team member or a consultant.

Comparison to Business As Usual (BAU)

If there was no EEMs implemented, the scenario can be termed as “business as usual” or BAU. The energy baseline is used as a reference point to estimate and measure energy savings pre-EEM and post EEM. This energy saving is the difference between the forecast baseline in the business-as-usual (BAU) case (without opportunity implementation) and baseline post-opportunity implementation. The majority of energy savings cannot be measured directly, but are normally calculated from a comparison of pre- and post-implementation energy consumption.

2.2.4.5 Case Study – INFOSYS : Benchmarks, Baselines & Audits

Rohan Parikh, Head of Infrastructure and Green Initatives at Infosys made a passionate presentation to the Infosys Board about sustainability initiatives. He was asked to set himself unreasonable goals by the Chairman, Mr. Narayana Murthy and thus started the journey. The initial budget that was requested was not large, considering what was required was mainly for energy metering to establish a baseline.

Baselining :

The following is a step by step baselining procedure followed by Infosys :

- The first and the most important step was to meter the energy consumption in buildings across all the campuses. This was the only way to know the consumption levels and to assess the potential for savings.
- Energy meters were installed in every building and every chiller plant and the energy team were able to monitor building wise energy consumption.
- The employee count was available from the swipe data of employees when they get into the campus.
- The per capita energy consumption for Infosys was then calculated.
- Building energy in terms of area (kWh/sqm) was also measured through metering.
- At the same time, the energy data from the energy meters was matched with the energy bills paid monthly by Infosys.
- A central energy dashboard was created by the Facilities team to ensure accuracy of energy data, and consolidate energy and employee data for all locations.
- These numbers in 2007-08 were the first calculation of normalized energy data for Infosys buildings, and therefore became the baseline for comparison.
- 2007-08 : The per capita energy consumption of Infosys was 297 kWh/employee/month and our office building energy consumption was an average of 200 kWh/sqm/year.
- 2013-14 : The per capita energy consumption of Infosys was 167 kWh/employee/month and our office building energy consumption was an average of 85 kWh/sqm/year.

Audits:

- Accurate metering helped identify buildings with highest energy consumption and highest potential for energy savings.
- A few of such buildings were selected as a sample for a detailed energy audit, conducted by expert external agencies along with the internal teams.
- The external agencies carried their own calibrated instruments for measuring power, temperatures, flow rates of water and air, etc.
- These audits consisted of assessment of air conditioning systems – measuring efficiencies of each of the equipments like chillers, pumps, cooling towers, air handling units and optimizing operational and maintenance parameters.
- It also consisted of lighting system assessment that included measuring of lighting levels and lighting power, UPS assessment – measuring UPS efficiency and operational parameters.
- These audits highlighted a great potential for improvement by changing system design, equipment replacement like chillers, pumps, and fans.
- An estimate of cost vs energy reduction was calculated and presented to the management.
- A retrofit budget was allocated for a few buildings and the before and after energy consumption was clearly documented to verify and ensure we achieved the savings through the implemented energy efficiency measures.
- Once the savings was observed (which was more than estimates), it helped in getting the confidence of the senior management to invest in similar efficiency measures in all buildings across Infosys locations. Thus started one of the biggest retrofit programs in commercial buildings industry.

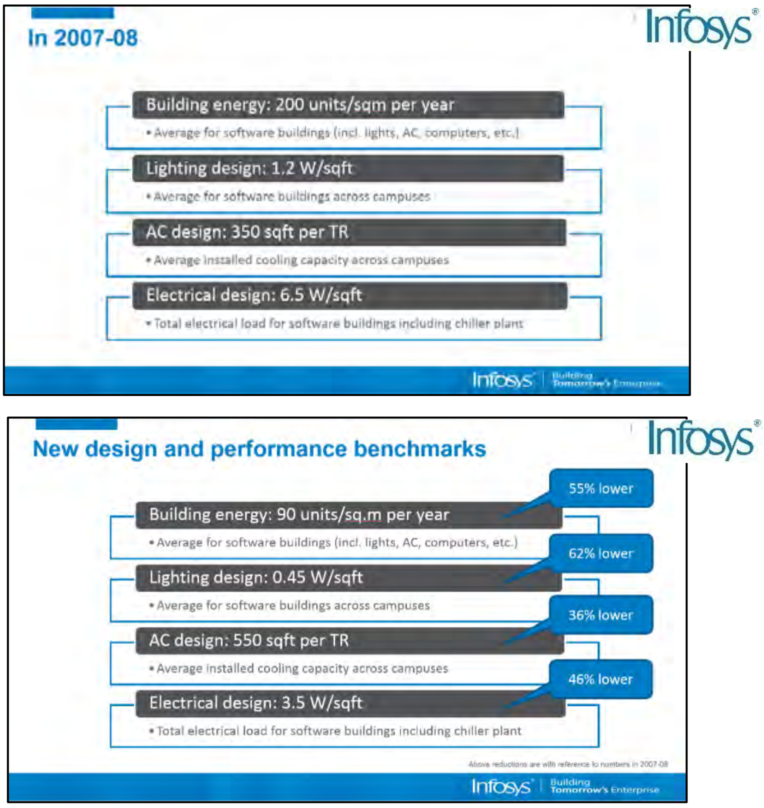

Figure 3.7: Energy Efficiency Progress by Infosys

2.2.5 Energy Efficiency Measures (EEMs) – Value, Cost & Complexity

This section will provide some guidelines and data points on the different complexities, cost and value for EEMs and specific steps to handle such complexities.

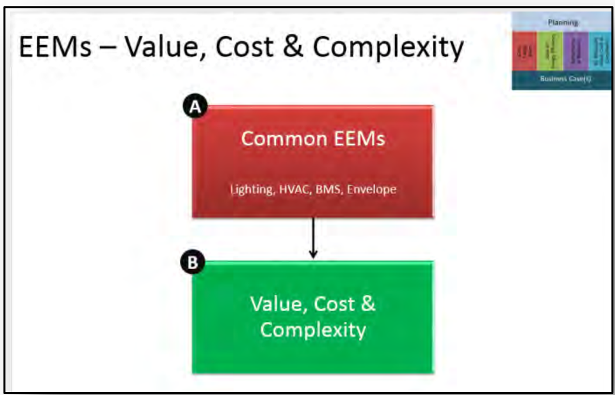

Figure 3.8: Energy Efficiency Measures, Value, Cost & Complexity

2.2.5.1 Common EEMs

There are a whole host of commonly quoted energy efficiency measures (EEM) ranging from simple things such as replacing lighting with LED or high efficient lighting, to more involved measures such as replacing motors and drives with Variable Speed systems to really complex systems such as implementing on-site renewable technologies such as PV Solar.

Prior to embarking on a major energy efficiency project, sometimes it is better to implement and execute EEMs which are straightforward and do not require a high degree of expertise. Some preliminary and basic financial analysis may need to be done based on the base-lining and energy audit exercises, however in most cases this will not require a high cost commitment and can definitely provide the ability to address the proverbial "low hanging fruit".

Such low hanging fruit normally require little or no economic analysis and should be addressed or operationalized using an operating budget (opex), rather than going through a full cycle of financial and management approval cycles required for capital expenditures (capex).

Lighting

Lighting is a good first step to undertake in EEM implementation. It is fairly straightforward and the technologies are well defined. Typically, state of the art, enhanced lighting technologies have control systems to minimize the electrical consumption of lighting systems in the building. Therefore, while doing a lighting upgrade, it may be prudent to consider control technologies as well, which will overall help reduce the operational costs of the lighting system.

The goal of a good lighting strategy is to ensure visual comfort (providing adequate levels of high-quality light when needed) based on task , while reducing the energy consumed (watts) and/or reducing the hours of operation. Some examples of common lighting upgrades include converting fluorescent T-12 lamps and magnetic ballasts to T-8 lamps and electronic ballasts and installing LED exit signs.

Potential energy savings from enhanced and/or centralized lighting controls will vary depending on many factors such as existing conditions (hours of use, type of lighting, and more). In buildings which are pre 1986, up to 25 percent of the electric lighting energy consumption can be saved with little or no user impact. In newer buildings, there are still many opportunities to save energy based on the lighting systems.

HVAC

Similar to lighting, many significant opportunities exist to improve the efficiency and savings levels of the HVAC systems for most buildings. When adding or retrofitting enhanced control HVAC control systems, typically the process is more complex and a more detailed analysis is necessary to determine the practical viability practicality and cost-effectiveness of the project.

Enhanced HVAC technologies refer to integrated systems with improved energy management capability to manage the operation of single or multiple-buildings from remote locations. Typically these energy management technologies and systems get data from a large number of sensor points that measure and record parameters such as temperature, humidity, pressure, flow rates, power usage divided by zone or floor or functional use in the building. Several technologies described in this section are stand alone, but more often than not, they act in concert with one (centralized control system) another providing a greater degree of optimization.

Energy Management System (EMS)

Most modern buildings have some form of building management or building automation and control systems (BACS), however there is a need to look at buildings in a more holistic manner to optimize energy performance even further. An Energy Management System (EMS) provides much greater functionality than a standard BACS, through more advanced system control strategies. This is done with the help of "supervisory" control programming requires additional monitoring and control system parameters than traditional BACS systems for successful operations.

An EMS has the ability to provide building owners and facilities / energy managers with centralized monitored, analyzed and control features. It is an information and control system which optimizes end-use equipment using computers, application software, customized database, a data communications network and a series of control devices and data sensors. Parameters measured could range from air temperature, humidity, water temperature, lighting levels just to name a few, all of which act in concert to provide a holistic energy view to the EMS for optimized energy strategies.

It is estimated that an efficient BACS could reduce up to 10-15% of the energy consumption of a commercial building, if correctly monitored.

Building Envelope

It is estimated that upto 40 % of the energy used to heat and cool an average commercial building is lost to the phenomenon of uncontrolled air leakage through the building envelope. If we assume that commercial and residential buildings accounted for 40% of total energy it means up to an astonishing 16% of our total energy consumption may be wasted every year due to the building envelope.

The building envelope – the interface between the interior of the building and the outdoor environment, including the walls, roof, and foundation – serves as a thermal barrier and plays an important role in determining the amount of energy necessary to maintain a comfortable indoor environment relative to the outside environment. It plays an important role in energy equation for a building because it acts as a modifier of the direct effects of climate variables such as the daylighting, outdoor temperature, humidity, wind, solar radiation and rain, which are the parameters influencing the energy requirements and thermal comfort within a building.

The envelope is made up of all of the exterior components of the building, including walls, roofing, foundations, windows, and doors. Insulation, building paper, and other components aimed at controlling moisture and airflow are typically included in the building envelope design. Therefore, any improvements made to the building envelope such as insulation, type of glazing, façade treatment, day lighting systems all are examples of energy efficiency measures to the envelope.

Quality of implementation of such measures has an important impact on the energy efficiency achieved and should be checked.

2.2.5.2 Value, Complexity and Cost

A lot of the EEMs may have been identified during the various energy audits conducted and should be bucketed into three categories (1) Value, (2) Cost and (3) Complexity – all of which need to be sub-divided into Low, Medium and High.

Value is in terms of the company in terms of Energy Reduction or Economic Value – ie a very fast RoI (short timeframe). Some non-tangibles such improved Brand Equity or an Award / Recognition could also be considered. Value can also been seen in terms of the time effect of an EEM – a change in a control variable in a BMS may last 1 year, changing out a constant speed chiller to a variable speed, 15 years and perhaps a window into low emissivity, high efficiency glass 30 years. The actual tangible value will need to be established on a case by case basis depending upon the actual EEM and the original state of the building prior to the implementation of the EEM.

Cost is equally important and refers to the upfront capital cost for implementing the EEM. It could also mean costs coming from an Operational budget.

Complexity is in terms of technical expertise required, skills available in-house and impact to the end-users/employees in the building (ie can these EEMs be performed with minimum or medium impact)

The table below frames what may be a qualitative manner to assign Low – Medium – High tags to the above categories. These qualitative measures will vary and could be specific to a given organization's own situation and should therefore be customized as needed.

In cases where the Cost and Complexity is Low / Medium and Value needs to be calculated / estimated especially in terms of an RoI, a simple spreadsheet can used with an NPV type of calculation to establish where the Value lies. In addition, executive level approval for such projects may not be needed and final decisions taken by the Energy Director in consultation with the Energy Team.

For higher cost and complexity cases, it is likely that a more stringent RoI model which may need to muster formal support and approval from CXO level staff, especially in the case where substantial new funds will be requested.

Category	Low	Medium	High
Value	< 10 % Energy Savings RoI > 5 years	10 % < Energy Savings <25 % 5 Years < RoI < 3 Years	Energy Savings > 25 % 3 years < RoI
Complexity	Internal Team can handle Low Impact to Business/Staff	Outsource to External Team Some Impact to Business/Staff	Specialized External Team High Impact to Business/Staff
Cost	Absorbed by OPEX Less than $ 100 K	Partially OPEX, Need New CAPEX $ 100 K < Cost < $ 500 K	Need CAPEX $ 500 K < Cost

Create an Opportunity Class Index

An ideal EEM will be High Value, Low Complexity and Low Cost as illustrated above, but this is not always the case and so a matrix needs to be developed to see and rank what are the different potential combinations. This can be termed as a Opportunity Class Index (OCI) which can then be further refined against a business case.

Value	Complexity	Cost	Opportunity Class	Value	Complexity	Cost	Opportunity Class
High	High	High	C	**Medium**	Medium	Medium	C
High	Medium	High	C	**Medium**	Low	Medium	C
High	Low	High	C	**Medium**	High	Low	B
High	High	Medium	B	**Medium**	Medium	Low	B
High	Medium	Medium	B	**Medium**	Low	Low	B
High	Low	Medium	A	**Low**	High	High	D
High	High	Low	B	**Low**	Medium	High	D
High	Medium	Low	A	**Low**	Low	High	D
High	Low	Low	A	**Low**	High	Medium	D
Medium	High	High	C	**Low**	Medium	Medium	D
Medium	Medium	High	C	**Low**	Low	Medium	D
Medium	Low	High	C	**Low**	High	Low	D
Medium	High	Medium	C	**Low**	Medium	Low	D

The above table reflect 26 possible combinations and a natural fallout of the form of ranking in the form of "class of opportunity" A, B, C and D. (the 27^{th} option which is Low, Low and Low is not presented, since it realistically will not make the cut)

- Class A is a clear winner – High Value and Low / Medium Cost and Complexity.
- Class B is also a really good candidate but does require some further introspection.
- Class C requires more due diligence.
- Class D is typically a non-starter.

It should be recognized that this approach may work individually for EEMs but when a group of EEMs are done concurrently, there could be inter-relationships between the different EEMs where 1+1 is not 2 but (1 + 1 could be) 3 or (1+ 1 could be) even 1.5. This needs to be considered as well.

Project Opportunity Identification and Evaluation

A process to identify potential opportunities needs to be implemented and documented. The process should involve review of information, data and analysis and use of necessary people, and result in a comprehensive list of opportunity areas. The business aspects of the analysis is discussed in greater detail in the next section.

One option for example could be based on the OCI matrix developed for a given set of EEMs, the choice of all A class and B Class opportunities could be shortlisted as a first cut. These shortlisted opportunities will then need to be further analyzed using a detailed business case as discussed in the next section.

Detailed investigation should be undertaken of opportunities to evaluate costs and associated benefits up to a accuracy of +/- 25 %. Detailed investigation may include sub-metering or real-time metering to a sufficient level of detail to understand the energy use of major systems and items of equipment. If it turns out that a level of accuracy of 25 % cannot be attained, an appropriate methodology needs to be developed to break the problem down further and achieve an accuracy to within 25 %.

A good rule of thumb would be to consider opportunities which end up with a payback of less than 3 to 4 years. These can be considered and put into a shortlist of 'opportunities for implementation' or 'opportunities for further investigation'. Reasons for not pursuing specific opportunity areas need to be documented.

2.2.5.3 Case Study INFOSYS – Some example EEMs implemented

INFOSYS – Building, HVAC & Sensor EEMs

Building-Envelope Efficiency

An efficient building envelope is one of the most important aspects of an energy-efficient building. It is essential to reduce the heat ingress in a building thereby reducing its cooling requirements. Up to a 15% reduction in the peak cooling load and a 6-8% reduction in annual energy consumption can be achieved through an efficient envelope. This covers appropriate orientation, insulated walls and roofs, an optimized window-wall ratio (25-30%), and high performance glazing with adequate shading. All buildings that have been constructed on Infosys campuses have been fitted with efficient building envelopes, reducing the related heat gain to 1 Watt per square foot of air conditioned area. Experience has revealed that the reduction in cooling and electrical equipment provides for the additional investment required for efficient envelopes. This technology has been implemented at buildings that were constructed after 2008 at the following campuses : Bangalore (MC building), Mysore, Pune, Hyderabad (SEZ campus), Jaipur (SEZ), Mangalore (SEZ), Thiruvananthapuram (SEZ), and the upcoming new campuses at Bhubaneshwar, Indore, and Nagpur.

Radiant Cooling Technology

Infosys has been a pioneer in implementing new building technologies in India. The first radiant-cooled commercial building in India was constructed at the Hyderabad campus. Operational data for the last two years show that radiant cooling is about 30% more efficient than conventional air conditioning. Radiant cooling also has a lower initial investment compared to conventional air conditioning, thus making great commercial sense. Currently, eight buildings at Infosys are being designed using radiant cooling technology. This technology has been implemented in buildings at the following campuses: Bangalore (MC building), Mysore (SDB 7 onwards), Pune (SDB 11), Hyderabad (SEZ campus), Jaipur (SEZ), and Thiruvananthapuram (SEZ – SDB 4), and the upcoming new campuses at Indore and Nagpur.

Wireless Technology

Energy-harvesting wireless technology for self-powered wireless switches, sensors, and controls for building automation cuts the cost and time of installation, and enables the efficient use of energy. This technology is based on the energetically efficient exploitation of slight mechanical motion and other potential from the environment, such as indoor light and temperature differences, using the principles of energy harvesting. It is now possible, with low investments and minimal disruption, to outfit buildings with self-powered, 'peel and stick' sensors and switches that seamlessly connect to Transmission Control Protocol (TCP) / Internet Protocol (IP) communications. This technology is being piloted in a new building at Bangalore (MC building) and based on results will be implemented across new buildings in the future.

Variable-speed pumping system in AC systems

Our air-conditioning systems are among the most efficient globally. In the conventional systems, two sets of pumps (primary and secondary) are used for distributing chilled water. In the variable-speed primary pumping system, only one set of pumps is used. Also, each pump is directly connected to the chiller, reducing the piping. This also eliminates the need for using balancing valves, thereby reducing the pressure drop, and decreasing the capacity of the pumps, which further reduces the initial investment. This has been implemented across all Infosys Indian campuses.

INFOSYS - Lighting EEMs

Lighting controls for greener results
Intense research in the use of lighting infrastructure across Infosys operations has yielded several innovative solutions and processes. These include technology and design solutions. These solutions have been implemented in all buildings that were constructed after 2008 across the following campuses: Bangalore (MC building), Mysore, Pune, Hyderabad (SEZ campus), Jaipur (SEZ), Thiruvananthapuram (SEZ), Chennai (SEZ) and Mangalore (SEZ). The plan is to implement these best practices at all future buildings that Infosys will construct across different campuses.

Daylight panel and vision panel for windows
With the aim of using natural light through the day, all new buildings at our campuses since 2008 have been designed with daylight and vision panels. The window is split into two different types of glass. The upper glass is called the daylight panel and is usually of a higher visible transmittance (more transparent), in order to get natural light into the office space. The lower glass is called the vision panel with low visible transmittance. This type of window is highly efficient because it lets in good natural light with little or no glare, and also minimizes heat gains into the building. In most of the new Infosys buildings, with narrow floor plates (18 m or less), almost 100% of the office space is naturally lit using this design. This ensures the lighting load is very low during the day and provides a comfortable ambience for employees.

Light shelves to improve daylight in office spaces
The light shelf is an architectural element. An overhang fixed between the vision panel and the daylight panel, it extends outside the building as well as inside. The light shelf helps reflect natural light deep into the office space, and provides protection from glare.

Volumetric lighting in office spaces
The aim is to provide lighting levels according to global standards, with a focus on the quality of light. Lighting designs are aimed at lighting up the space (volumetric lighting) and not just the employees' desks. This increases the overall visual comfort for employees, and has no additional cost impact.

Accurate lighting design through simulation and controls
Lighting designs are based on simulation software, which indicates the optimum number of light fixtures needed to achieve the required lighting levels. This will eliminate the use of rule-of-thumb designs, thereby reducing lighting loads and subsequently, cooling, and electrical loads. Daylight sensors in perimeter areas and occupancy sensors for all cabins and restrooms reduce the operational costs. Infosys lighting designs are about 50% more efficient than the global American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) standards, and our lighting energy consumption has been reduced to one-eighth of the consumption in old buildings. The accurate design of Infosys lighting systems has involved a lower investment, since the number of fixtures and lamps has been optimized and wastage is thus completely eliminated.

Replacement of sodium vapor lamps with LEDs
Infosys replaced the 250W sodium vapor lamps used for street lighting with 75W LEDs, resulting in a 70% reduction in their connected load. The payback period for this measure is three years. The life of LEDs is several times higher than that of sodium vapor lamps, thus reducing maintenance or replacement costs. This has been implemented across all Infosys Indian campuses.

2.2.5.3.1 Case Study – Building Envelope Energy Efficiency Measures

The Asahi Glass Company (AGC) European Headquarters in Louvain-la-Neuven, Belgium, This office building (2013) received the BREAM Excellent certification in design stage is designed to be a nearly zero energy building. Its façade combines a solar-control double glazing with thermal insulation covered by a unique system of silk screen-printed automatic louvers to improve the solar protection and glare control. All glass products used in the building obtained a cradle-to-cradle certification at silver level. This is an example of a Building Envelope EEM which while developed for a new building can also be applied in terms of retrofits as a secondary façade.

Another example of Building envelope EEMs can be observed in a LEED Platinum rated office building known as the Main Point, located in Prague, The Czech Republic. The double-glazed facade of this building combines both Low- Emissivity and Solar-control properties to minimize heat losses in winter and avoid excessive heat gains in summer. Beneath the vertical colored stripes on the external shell, the facade is nearly fully glazed from the inside.

2.3 Develop Business Case

1. Linkage to Current Business Priorities	3. Perform Financial, Benefits & Risk Analysis
2. Involve Key Stakeholder & Decision Makers	4. Write the Business Case Proposal

After establishing a foundation as discussed in Chapters 3 and 4, the next critical piece of the puzzle prior to implementation, is the **business case** to implement such Energy Efficiency Measures (EEMs). The organization must find that these proposed EEMs have tangible value whether in terms of money or employee productivity or brand equity.

The following statement[22] exemplifies and underscores the importance of being able to articulate the financial value of an energy efficiency project :

"Any energy improvement project proposal should be communicated in language CFOs understand. Expressing the savings, benefits and financial value of a project can help to get projects approved only if the terms used to express those criteria are understandable."

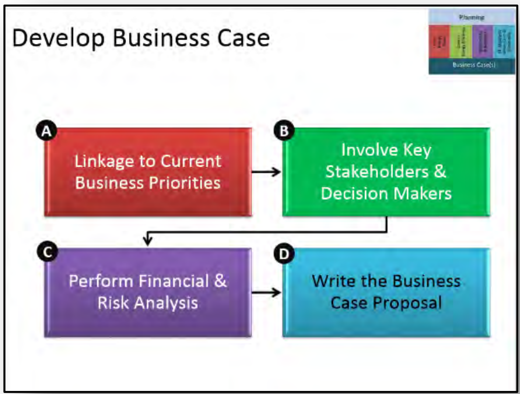

Figure 2.3.1 : Developing the Business Case

This section is intended to provide some guidance and suggestions to the Energy Team to develop and present a successful, meaningful business case. All of the suggestions need to be adapted specifically to the given energy efficiency programs being implemented.

Reducing energy consumption and improving energy efficiency can have a positive impact such as improving the bottom line, reducing operational expenses, improving productivity, reducing greenhouse gas emissions – all of which can also help establish the organization to be socially responsible.

Very high performance buildings also show leadership of the company in terms of sustainable development. It attracts job candidates as well as customers. Showing building certification beyond building codes shows innovation and vision.

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[22] http://www.facilitiesnet.com/facilitiesmanagement/article/Getting-Through-to-the-CFO--8224#

Having said that, despite these and other intangible benefits, it is very often very difficult to obtain the management support and the financial wherewithal needed to implement energy efficiency projects. The barriers are most often finance related, which means that a business case highlighting and quantifying the benefits of the energy efficiency opportunities is essential. While active savings are good, sometimes it is necessary to highlight the downside of “business as usual” (hidden savings).

Cost savings are a primary motivation for organizations to become more energy efficient. The idea is to use monetary incentives such that a given set of resource inputs are used more efficiently. In order to try and obtain the greatest returns on investment, different energy efficiency opportunity scenarios may be evaluated including the choice to make capital or operational improvements that yield reductions in energy costs.

2.3.1 Linkage to Current Business Priorities

If the EEMs being considered can be aligned with existing business priorities and imperatives, management approval will become a lot simpler. These business priorities need to be well understood in order to align the case for energy efficiency with core business objectives.

The following are examples of some approaches and opportunities to achieve that alignment – although the specifics will depend on the case in point.

- Gain a fundamental understanding of existing business plans and priorities within the organization and work with the management team to develop a strong nexus between the overall direction of the business and energy policy and associated strategies.
- Study other organizational goals, targets and programs and determine if the energy efficiency project (EEP) can “piggyback” on whatever is ‘hot’ within the business right now.
- Study new compliance requirements to see if there is a possibility to bring a new focus on energy efficiency
- Solve an existing problem through an energy efficiency project . Identify ”problem” or “pinch points” within the organization and see if their resolution can be enhanced via energy efficiency – for example, increasing the productivity of employees as well as deliver an energy savings .
- Use any plans for new buildings, construction, retrofits, site expansion to ‘design in’ energy efficiency. For example, if equipment is due for replacement then this may be the main focus of the business case proposal with the energy efficiency outcomes acting as a co-benefit.
- Look for the “low hanging fruit”, i.e. develop your business case for low and no-cost initiatives when capital is difficult to access and there is a focus on cost savings
- Look for the most efficient options when procuring new equipment
- Implement projects during maintenance shut-downs to optimize on costs and “down time”.
- Build energy efficiency into practices and procedures, for example in maintenance and operations.

2.3.2 Involve Key Stakeholders & Decision Makers

A business case proposal cannot be developed in isolation or in silos. Getting the right people with different expertise involved is critical build a credible business case for a project . The right set of people with complementary skill sets need to be brought together for successful development and execution of the business case proposal. A broad set of skills in the business case process will provide a level of comfort to the senior management that multiple facets of the problem are being addressed.

Asking the right questions and getting the right data are all critical to the process. In addition, with more people involved, there is a sense of "ownership" within the organization which could lead to widespread support for the effort.

2.3.2.1 Key Stakeholders

There two sets of stakeholders – Inernal and External. Both play an important role in the energy efficiency aspects in a corporate environment,

Internal Stakeholders. It is essential that the right cross section of people across the organization have been consulted especially in terms of risk assessment and quantification of business costs and benefits. Staff who have demonstrable financial expertise will always be an asset. This will ensure that the business case is complete and credible.

One good way is to make a potential list of key stakeholders and determine:

(1) The potential interest and/or benefit to them in the proposal.
(2) How can they help the project ?
(3) What action will be needed to get them involved ?

Some examples of the people and expertise that you might need to involve as you develop your business case proposal include:

Possible Internal Stakeholders	Engagement
Mid-Level to Senior Management	A good understanding of the business and often extensive experience in the industry
3rd Parties – Consultants, Technology Vendors	Work closely with suppliers, customers and other external stakeholders to not only gather information to help the business case but also to clearly establish the roles and responsibilities early so that all parties are clear about the decision-making process.
Finance Personnel	Provide insight and details on the financial aspects of the proposal to help clarify and overcome internal and external financial barriers to action. Use them for helping construct the financial parts of the business case.
Marketing & Communications Team	Utilize their communication skills to develop convincing presentations of proposals to management and other staff, thereby raising the profile of your proposal
Business Analysts / Managers	Analytical skills and experience to develop business case proposals at the right level of detail, which align with key business drivers
Technical / Facilities Management Staff	Detailed experience and knowledge of plant, equipment and operational issues
Procurement Staff	Financial and supply risks that may be relevant to your business case proposal.
Energy Management Staff	Experience in operating and monitoring energy BACS, equipments or

Possible Internal Stakeholders	Engagement
	installations..

External Stakeholders. External stakeholders have a big role to play as well. It is essential to have a good engagement with such entities for a successful energy efficiency plan.

Possible External Stakeholders	Engagement
Local Community	Ensuring that any activities undertaken have minimal negative impact on the community and hopefully a positive uplifting impact.
Vendors / Alliance Partners	Sustainable procurement policy and vendor selection process. Appropriate vendor review meetings and awareness sessions as needed.
Government	**Local Government – Mayor, City or county council** - provide leadership on policies requiring legislative action **Local government agencies** - maintain government data and analytic capacity and have policy and implementation jurisdiction in sectors of interest **State and federal government** - provide resources, tools, and best practices information and may provide technical and financial assistance **County, regional, and neighboring local governments** - provide opportunities for cost and information sharing on programs with common goals
Academia	Provide expertise, analytic support, and/or a neutral forum to convene stakeholder meetings Participation in events involving academia White Papers
Investors	This is especially important in a publicly held company, wherein a section of investors may be asking for a clear sustainability storyline.
NGOs	**Environmental and consumer organizations** - provide data, analysis, and feedback
Utilities	Are typically the primary source of end use energy and hence play an important role. They can provide data and analysis about electricity markets.
Public At Large	**The public** - provides new ideas, input, and feedback to the local government

2.3.2.2 Decision Makers

There may be some external decision makers such as local licensing / permit providing agencies but that maybe more procedural and regulatory. Internally there needs to be full support as well from the decision makers within the company.

Basically you have to do your internal lobbying when you want a decision taken. The decision has to be approved before formal presentation. Each energy efficiency project will involve different decision-makers, each of whom different functions and tasks (therefore different business priorities) have and so it is very important to understand who these individuals are and their areas of responsibility. Since each of these decision makers may have a different functional role, a different level of cognizance and understanding of the energy problem at hand, the messaging and convincing arguments will need to be customized and targeted.

The set of decision makers will vary by the type of EEM project and business case. It will depend upon the type of project, the management level at which sign-off needs to occur and whether financial support or 'buy-in' is needed to help implement the project.

These discussions with decision-makers will help raise their awareness and build support for the EEM project being proposed. Another benefit to having such discussions will enable the energy team to test some of the EEM ideas early in the process and gain valuable insights into the benefits which should be highlighted as well as potential concerns and risks which will need to be addressed.

The following are some common tips and suggestions

- Obtain the support of key decision-makers by getting to understand how their roles / goals and objectives may benefit from the EEM project.
- Engage with these people as early as possible, this provides an opportunity wherein the decision makers may take implicit ownership of the project, which will help make the approval process easier and smoother.
- Once engaged, keep a continuous, regularly spaced dialog with them, keep them informed on progress.
- Leverage this relationship to develop new and other relationships in the organization to ensure success of the project. For example if the CTO is interested, leverage that to develop a relationship with the CFO.
- Seek advice and guidance – make them part of the process.
- Use any evidence-based data and information to support the business case
- Test out some of the perceived benefits, risks, mitigation with these decision makers.
- Ask for examples of previously successful proposals and what made it a success

The table below forms a sample of different types of decision makers within an organization and some guidance on how their support can be obtained.

Decision maker	Role & Interest	How to get their support
Executive / General Manager	Overall responsibility for the business including approval of major investment decisions.	Relate energy efficiency to the main functions of the company. Provide context in terms of other sites or companies and the benefits. Explain major risks and how they've been addressed. Speak of Sustainable image of the company, leadership, risk on asset value and lowering operation costs.
Site / Facility Manager	Overall responsibility for operations and/or delivery of services on the site.	Relate energy efficiency to efficiency and safety & cost reduction targets. Provide contextual benchmarks in terms of other sites or companies and the benefits. Explain major risks and how they've been addressed
Finance	Executive role with responsibility for managing business or site expenditure.	Understand current investment priorities and challenges. Seek support by asking guidance via examples of effective business cases. Seek help in constructing business case (gain sense of ownership in process)
Environmental / Energy Manager	Typically will be leading Energy Team. Responsibility for environmental and energy management and compliance across the business/site.	Maybe first stop on the way to other decision makers. Make it to be a team effort. Discuss links between energy efficiency and environmental issues within the company (e.g. GHG, Source Energy consumption, Water, Waste) and how better data on energy will help.
Users / Employees	These stakeholders will be key to making the EEMs a success (or not…)	This is Key. Need to help making the case that after the implementation of the EEMs, their overall ecological footprint will be reduced compared to before the EEMs .

2.3.3 Perform Financial, Benefits and Risk Analysis

There are a number of key aspects related to Finances, Benefits and Risks for every EEM.

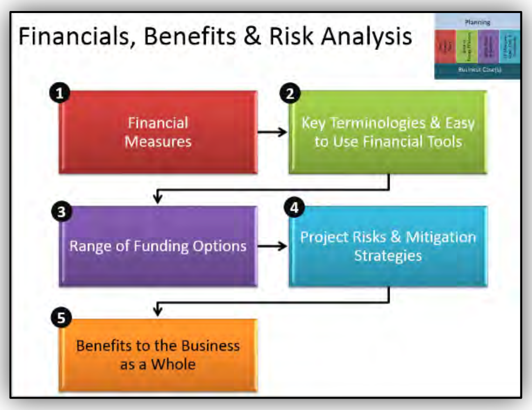


Figure 4.2 : Financials Benefits and Risks

2.3.3.1 Financial Measures

Financial measures are typically the most important part of a business case and are a "must have".

These measures are particularly valuable because these are used to calculate the return on investment for the EEM opportunity. Estimates of costs and savings need to be prepared to a sufficient level of detail and accuracy that enables the decision makers to make an educated investment decision. The level of detail and accuracy is of course commensurate with the scale of the project.

A robust financial case is essential for credibility. The development of the financial case is therefore critical or "must have" and non-financial aspects only bonuses or "nice to have" . If the financials do not meet the metric set by the management team, the non-financial benefits will matter little.

There are two primary aspects to the financial case – The Projected Energy Savings and the Cost to Implement. Both of these must be computed very accurately and validated and verified before being inserted into the business plan.

Projected Energy Savings

This translates into reduction in operational expenses due to the reduced use of energy. In the case of the expected savings in energy consumption, the energy manager is usually on safe territory, since this has become increasingly more of a science and less of an art, with effective monitoring and targeting schemes and/or sufficiently detailed energy audits. However, these should still be validated by :

- consulting other users of the technologies being planned to be implemented on their experience
- use professional consultants for an independent opinion
- use modeling and simulation

If there some concern on whether the EEM will scale and actually deliver the results predicted, one option would be to request sufficient funds for a "pilot" program and only after actual result show that there benefits are indeed true, a larger, full scale implementation to be done. The lifetime of an EEM – i.e. how long the EEM will last and continue to give energy dividends is important to consider.

Costs of implementing the EEM

These need to be validated based on multiple quotes of not only the equipment or technologies but also implementation and commissioning costs.

- Source the information from multiple vendors and system integrators as appropriate.
- Try to ensure that the project be done on a turnkey basis, thereby making one party responsible for the overall successful technical implementation.
- Get "no overrun" guarantees by making the quotes to be fixed cost

2.3.3.2 Key Terminologies & Easy to Use Financial Tools

There are many different financial terminologies and methodologies such as Simple Payback (SP), Discounted CashFlow (DCF), Return on Investment (RoI), Internal Rate of Return (IRR) and Net Present Value (NPV).

With so many types of methods, it can be confusing, especially for an energy manager or team to decide which method to use and what to present to the senior management.

While NPV is quite common, there is some tendency of firms when making decisions for energy efficiency projects especially, to use capital budgeting methods such as simple payback and IRR to evaluate prospective investments. Engineers are typically seen to prefer a simple approach of using simple payback.

In general, as a guiding rule, NPV is a preferred method to do financial evaluation especially in terms of capital budgeting and investments. This is of course, assuming equivalent project lives, levels of risk, a constant future cost of capital, and access to capital markets.

There are many financial tools available to develop a business case. However, only a few of them have been developed with a 'building energy efficiency" lens. The US EPA[23], as part of its Energy Star[24] program has the following (free to use) tools which can be downloaded from their website.

Such tools can be used as a first cut analysis to determine the financial viability of a given energy efficiency measure or opportunity. One aspect to remember while doing the financial analysis is to ensure that the default costs of energy are not used – the actual, local energy costs must be utilized to the ensure a proper financial picture. In most cases, these tools will suffice to muster the support of the management team. More detailed analysis then can always be performed as needed.

While other calculators do exist, and this report is not endorsing the US EPA tools, they are being provided as a reference that users of this Toolkit can download and try to establish if it meets their needs.

The three calculator tools that the US EPA has developed are :

[23] http://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/find-financing/calculate-returns-energy-efficiency

[24] EPA Energy Star : http://www.energystar.gov/

- Building Upgrade Value Calculator (BUVC)[25]
- Cash Flow Opportunity Calculator (CFO) [26]
- Financial Value Calculator (FVC)[27]

2.3.3.3 Consider a Range of Funding Options

Don't limit yourself to traditional funding sources. Know what is available and be creative. There may be many different sources of funds for the EEM project being proposed. For example, explore corporate funds which relate not just to energy but also productivity and efficiency. There could be special funds which are under the specific purview of the executive management for certain exigencies. There could be government matching funds for energy efficiency that could be leveraged and / or specially subsidized loan structures for energy efficiency projects. Can the project get funded out of operational budgets (commonly termed as opex) ? Are there any unexpended funds available since the annual fiscal year cycle is ending and may be freed up to pay for the EEM project ?

It is important to get a complete handle on the range of funding options which are available and the timing including budget cycle. This can make the difference between a project being implemented or just sitting on the shelf. Where possible, align your efforts with the budget cycle to ensure that there is momentum.

Some possible funding sources include:

Funding option	Description
Operational expenditure (Opex)	Funding to maintain business operations. Opex funds have a short term focus so are more suited to lower cost/shorter payback projects.
Capital expenditure (Capex)	One-off expenditure on items required to generate income in the future. Capex funds often have a mid to long term focus and may require a more competitive business case process to secure funds.
Business improvement funds	Energy efficiency projects may be eligible for funding through business improvement programs.
Corporate funding	For larger companies, potential sources could be the Corporate HQ
Government funds	These may not only provide funds but also tax rebates and a range of other incentives.
Alternative funding options	Energy Performance Contracts (EPC) are becoming common with respect to buildings. An energy services company (ESCO), which is a third party, guarantees the energy savings that will be delivered and in exchange gets paid from these savings for the term of the contract. Research Funds – These maybe available especially if trying out new and innovative EEM techniques. Low Interest Loans and other innovative funding options to implement

[25] http://www.energystar.gov/buildings/tools-and-resources/building-upgrade-value-calculator

[26] http://www.energystar.gov/buildings/tools-and-resources/cash-flow-opportunity-calculator-excel

[27] http://www.energystar.gov/buildings/tools-and-resources/financial-value-calculator

Funding option	Description
	energy efficiency projects maybe also available.

2.3.3.4 Evaluate Project Risks and Develop Mitigation Strategies

All projects have risk and the business case being presented must demonstrate that the potential risks in the EEM project being proposed have been identified, considered (evaluated) and have been mitigated or can be managed. Good results alone from an energy efficiency perspective may not be sufficient to pass muster with the senior management.

Financial Risks. One of the prime concerns will be if the funds being requested will be sufficient to deliver the promised results from the EEM, or will there be be a further request for more funds down the road (cost overrun). There maybe also be concern on the risk of not meeting the expected level of savings and other benefits from the project.

Market Risk. Consider what energy prices might do relative to other costs. What if the price of carbon emission permits were to collapse? What about interest rates?

- Technical Risk. This will be of particular concern where new technologies or practices are involved. Any project which uses new technologies that could impact core business operations or product quality can have significant cost implications.
- Safety Risk Safety is a major consideration in all organisations. If the project does involve potential safety issues then there will be a need to demonstrate how these fit into an overall schema of safety assessments and that the identified risks can be appropriately managed.

The table below summarises some of Potential risks, Questions to ask and possible Actions.

Risk Type	Questions	Actions
Financial risk	• Will the project deliver the savings predicted ? • Will the funds requested for the project be sufficient to deliver the project?	• Provide basis of estimate including past case studies, calculations, assumptions. • Ensure any quotes come from reputable sources. • Conduct sensitivity analysis to account for variability in the assumptions you make about the costs and benefits of your project.
Strategic risk	• Will the use of funds follow organizational policies and not hinder the ability to deliver other corporate goals?	• Demonstrate how the project links to existing corporate policies and strategies • Make sure company standard processes and policies are followed.
Operational-technical risk	• Will the project impact normal plant operations negatively ?	• Consult with the relevant managers and specialist expertise as required to ensure that there is minimal (none) disruption.

Operational-safety risk	• Will the project involve safety issues?	• Follow the formal safety risk assessment protocol for the organization .
Market risk	• What happens if energy prices drop ? • What if interest rates change dramatically ?	• Re-evaluate the business case with multiple scenarios : Conservative, Current and Aggressive.

Some tips for managing risk include :

- Follow existing risk assessment protocols when developing a business case proposal.
- Conduct a stakeholder analysis on the project and discuss risk-related issues with the appropriate people.
- Use trials or pilots to build understanding of potential risks and how they can be managed. Such an approach can provide the evidence needed to test deeply held "assumptions" about perceived risks.
- List each of the key project risks that have been identified and the strategies that will be used to mitigate those risks.

2.3.3.5 Benefits to the Business as a Whole

While a lot of focus will be place on the financial aspects of the benefits to the business (maybe rightly so) it must be noted that there needs to be some attention to non-financial aspects as well. All of these benefits should be considered in evaluating the business case so that the decision making senior management team has an understanding of all the benefits, not only the financials.

As part of the business case proposal, it is very important to present all of the benefits to the organization in a single package and clearly describing them. This can have a significant influence on whether the project will get supported or not. Relevant non-financial measures are equally important to include in the business case. They reflect a sense of completeness and demonstrate that there are tangible benefits beyond pure financial numbers should also be included in the business case. They can provide further justification for the project in terms of other business priorities such as productivity, competitiveness, corporate reputation and even employee satisfaction and comfort.

Some examples include:

- Reduced noise in ventilation systems after converting fans to variable-speed operation.
- Increased maintenance intervals to ensure equipment is operating at an optimum level of performance
- Improved comfort (temperature, visial, humidity etc.), improved productivity of the employees and reduced staff turnover
- Enhanced reputation and public relations advantage.

The table below provides some examples of such non-financial benefits which could possibly be used to bolster the business case.

Benefits	Non-Financial Benefits
Energy	• Total energy reductions (Joules) • Energy intensity measures linked to output (e.g. energy used per full time employee, per 1000 km travelled, per tonne of material moved, per

Benefits	Non-Financial Benefits
	tonne of product manufactured) • Energy rating (buildings) • Contribution of renewable, waste or locally produced energy.
Greenhouse gas emissions	• Total greenhouse gas emissions reduced (CO2-e)Greenhouse intensity measures linked to output (examples as per energy)
Productivity/ Services	• Increased productivity • % improvement in output • Comfort levels for tenants in commercial buildings (reduced complaints or positive feedback via survey) • Reduction in the frequency of employee downtime
Safety	• Lost time injury frequency rate • Hazards identified per employee
Employees	• Awareness of energy-efficiency related activities • Participation in voluntary energy-efficiency related activities • Job satisfaction related to company energy/ environment commitment
Community	• Awareness of energy/greenhouse gas reduction • Participation in energy reduction projects involving the community • Reduced community impact through productivity improvement e.g. reduced truck movements

Considering some quantifiable (possible) project costs and benefits such as :

- **cost reductions** (energy, repairs and maintenance, water use, waste, material, labor)
- **salvage value of surplus assets** (if equipment is left over and not needed)
- **avoided or deferred capital expenditure (if** lower energy use creates spare capacity)
- **productivity improvements** (especially if energy supply is a limiting factor)
- **greenhouse gas emission reductions**
- **self-consumption of energy (independency)**

Some additional benefits which are not easily quantifiable may include :

- **occupational health and safety improvement**
- **regulatory approvals**
- **corporate reputation with external stakeholders**
- **improved staff morale**

The following table outlines a list of potential "whole of business" benefits from Energy Efficiency Measures.

Waste	**Emissions**	**Operation and maintenance**
Use of waste fuels, heat, gas **Reduced product waste** **Reduced waste water** **Reduced hazardous waste** **Materials reduction**	• Reduced dust emissions • Reduced CO, CO_2, NO_x, SO_x emissions	• Reduced need for engineering controls • Lowered cooling requirements • Increased facility reliability • Reduced wear and tear on equipment & machinery • Reductions in labour

		requirements

Production	Working environment	Other
Increased product output/yields **Improved equipment performance** **Shorter process cycle times** **Improved product quality/purity** **Increased reliability in production**	• Reduced need for personal protective equipment • Improved lighting • Reduced noise levels • Improved temperature control • Improved air quality	• Decreased liability • Improved public image • Delaying or reducing capital expenditures • Additional space • Improved worker morale

2.3.3.6 Case Study – INFOSYS : Financial & Business Benefits

Between 2008 and 2013, Infosys has had a 93% increase in employee strength but the absolute energy consumption has increased only by 16%, in the same duration. They have saved 465 million units between FY 2008 and FY 2013, this accounts to 51 Million US dollars spent on electricity avoided.

2.3.4 Write the Business Case Proposal

The Business Case Proposal puts everything in perspective to allow executive management to make a business decision on next steps.

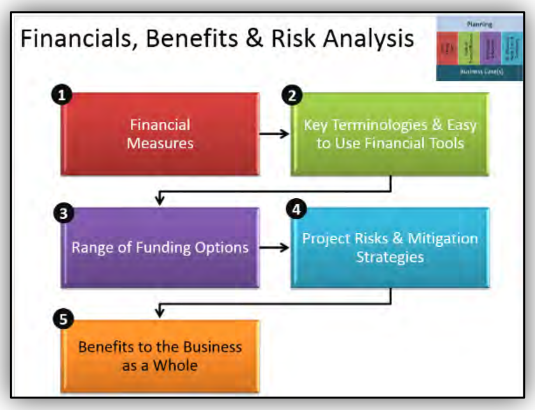


Figure 4.3 : Business Case Components

2.3.4.1 Clear Value Proposition and Approach

The proposal should commence with a concise summary of the project. This might include information on:

- Goals and Aims of Project including Quantifiable (How do I know its successful)
- Key financial aspects such a Payback Periods, Return on Investment (RoI) (details discussed in a later section) and other benefits
- The Ask - Funding and Resources being Requested
- Clear linkage between your project and existing business priorities.
- Potential Risks

It is important to document the approach and processes followed during the development of the business plan including all the key staff who have contributed or have been consulted. For example, the inputs / contributions by key internal (and external) stakeholders who have expertise in a particular area. If the project has already gone through several stages of "filters", state what those filters are. Such information will show that the project has internal support and provide the decision makers with more confidence in the proposal.

2.3.4.2 Financial & Technical Details, Benefits & Risks

This section of the business plan is key. It typically will start off with all the financials – costs, savings on energy and therefore cost, timelines, returns on investments, other business and non-financial benefits.

Financial

The type of financial analysis – Simple Payback or NPV and the Internal Rate of Return will need to be stated along with all the assumptions accompanying the financial case. The costs – capital and operating as well as energy savings translated into financial terms are necessary. These could be presented on the form of a table or graphs and figures – as appropriate and if the graphical representation enhances the message. The level of detail required will vary, but make all relevant data is included in appendices, or via a link to where they may be found.

Technical Details

Specific technical aspects of the project need to be captured and presented at a high level. If details are available and may be needed, put them in an appendix for easy retrieval. That will show that appropriate level of technical due diligence has occurred as part of the process Other planning, timelines, resource related aspects need also to be captured. Perhaps, internal and external communication plans about the project and its results could also be mentioned.

Benefits

In addition to the financial details, highlight key benefits that contribute to business improvement such as performance, process control, safety, risk management, compliance, corporate reputation, social responsibility and cost savings.

Risks

Often, there are some pre-conceived views within the management team, that the EEMs being proposed are high risk. The business case must clearly describe the known downside risks and plans to mitigate those risks. If corporate risk management policy and guidelines exist, these should be factored into the risk assessment as part of the business plan. Risks could include Technical. Cost, Operational / Safety and also Market Risk as discussed in a previous section.

2.3.4.3 The Ask - State Funding Needs / Type of Support Requested

This needs to be crystal clear. State the amount of money needed and where and how that is broken up – staff, consultants, equipment, travel, and 3rd party services and so on. State if it is OpeX or CapeX from within corporate budgets or external funding is available.

In addition to money and resources, what other additional support is being sought? Perhaps it is a message to all employees form the CEO, underscoring the importance of some EEMs

This section especially needs to be “to the point” and very explicit. The greater clarity in the”ask”, greater the chance to get funded.

2.3.4.4 Presenting Business Case to Executive Management

Tips on Writing the Proposal

- Use a concise, clear format.
- Be factual and to the point.
- Write with a ‘sense of urgency.’
- Use validated and credible data – internal, external and statistical – but make sure all information is relevant.
- Ensure that all graphs, tables and diagrams are clear and easy to interpret.
- Include other types of information if they will support your case, e.g. case studies or scenarios; benchmarking information comparing sites or competitors; interests of external stakeholders such as the community, customers and investors.

Understand your Audience

The management team or decision makers who need to approve the investments required for implementing the EEMs being recommended will have their own preoccupations and objectives. It is essential to determine what these biases are so that the business case can be aligned with their goals.

Note that in addition to corporate objectives, individual goals or views within the management team need to be addressed. This underscores the need for an ally in the form of a senior management sponsor.

Perhaps the most important question is: "What is the message that the board members want to hear?" That will define the opening statements in the dialog with the management team.

Key items: Brevity, Clarity, Certainty

"Pray inform me, on half a sheet of paper…" Sir Winston Churchill, when asking for critical wartime briefings.

- Start with a concise summary and put the detail in appendices.
- Graphs and diagrams are better than tables of numbers.
- Use photos, plant layout plans or even mock-ups to help people understand the proposal and its impact

Keep it Real and Tangible

Sometimes topics and subjects such as carbon emissions savings can become abstract and the management team may or may not relate to such terms – they may be construed to be abstract. The proposal should stick to the facts – especially in terms of energy saved or productivity and efficiency improvements and therefore the financial upside.

Keep it Professional and Explain All New Terms

Note that the senior management team evaluating the proposal could be unfamiliar with what may be considered common acronyms, jargon or technical terminology. In addition, few, if any, of the decision makers will have specialist knowledge of energy or carbon management. If the management feels uncomfortable with such terminology, there is a possibility of rejection.

It is therefore very critical to explain all new terms, especially acronyms and technical details, but if they are critical or essential to the proposal or argument, leave them out. Be cautious in referring to "keeping up with the competition", instead frame the language such that the results from the project will enable the organization to be "better than the industry peers".

The Final Presentation

It must be easy for the management team to absorb the message quickly

- What is the Project going to achieve
- What are the Business Imperatives
- What are the Risks
- What were the Options considered
- What is the Recommendation
- What is the ASK

Ideally, there should be only one recommendation and not a choice for the management team to make (if that happens, the energy team has not done its job). Its fine to show the different alternatives studied, but a clear winner must be presented.

2.3.4.5 Case Study – INFOSYS : Business Case Approach

INFOSYS – Energy Efficiency Measure Approach

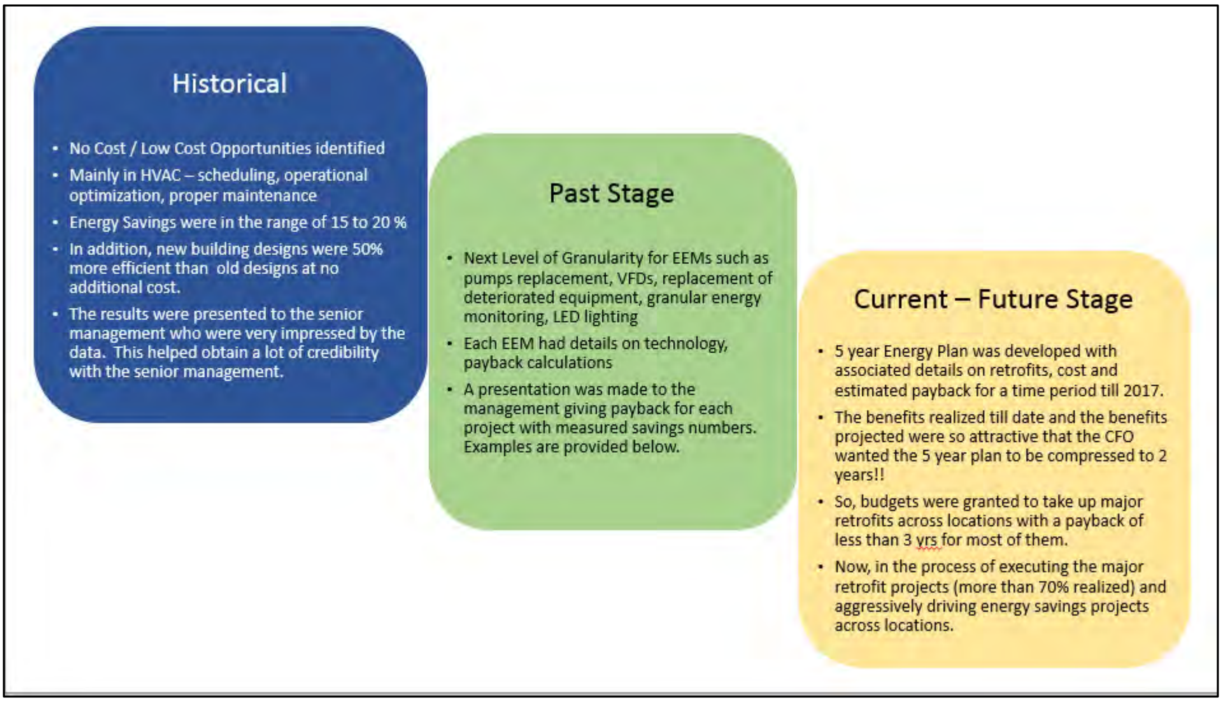
The Infosys team approached the overall energy efficiency storyline in stages.

1. First a baseline was established to estimate the energy savings possible via metering - *(" In God We Trust, All Others Bring Data" – Narayana Murthy, Chairman of Infosys).*

2. This was followed by identifying some "low hanging" fruit which involved energy efficiency measures which were not expensive to implement but gave a good savings. This built some credibility with the senior management who then asked for the next level of energy efficiency measures.

3. A detailed list of possible EEMs with appropriate payback calculations for a 5 year plan were presented to the management team, who asked for an acceleration of the plan to 2 years. Additional budget was granted to undertake major energy retrofits.

Infosys Energy Storyline

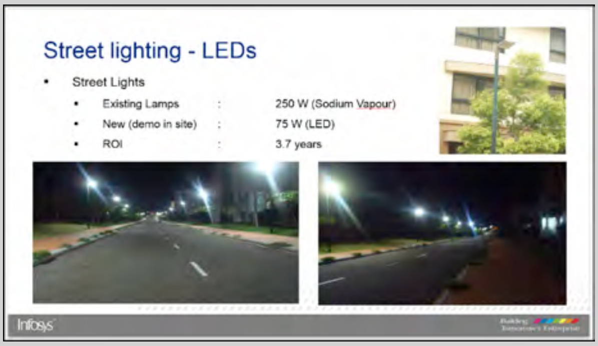


Example : Replacement of sodium vapor lamps with LEDs

- Infosys replaced the 250W sodium vapor lamps used for street lighting in their campuses with 75W LEDs, resulting in a 70% reduction in their connected load.
- The payback period for this measure is approximately three years.
- The life of LEDs is several times higher than that of sodium vapor lamps, thus reducing maintenance or replacement costs. This has been implemented across all their Indian campuses.

EEM Example : Street Lighting

Replace Street Lights in Campuses with LED Lights



Street lighting - LEDs

All locations	
Total no. of street lights across locations	2300
Cost per LED fixture	INR 12500
Total investment required	**INR 29,000,000**
Total load reduction	400 kW
Total energy savings estimated	1,500,000 units per year
Total cost savings estimated	INR 7,500,000 per year
Simple payback	3.7 years

Infosys

EEM Example : Chiller Optimization

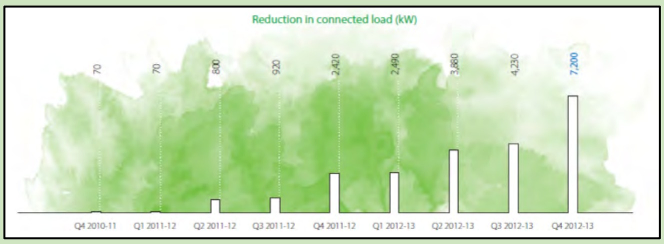
Infosys, has taken the energy efficiency of their new buildings to a new level by implementing innovative technologies and smart automation. Their buildings are therefore, among the most efficient globally. At the same time, Infosys has performed major retrofits at their existing buildings, particularly for the air conditioning systems, to bring them to the highest-possible efficiency levels. In the last three years, several chiller plants at their campuses have been retrofitted, to eliminate wastage, and bring about huge reductions in energy consumption.

The case for a retrofit begins with a detailed audit of all the equipment of the chiller plant, including the chilled water pumps, condenser pumps, cooling towers, and chillers. Over a period of time, the load in the buildings might have undergone changes through the replacement of equipment with newer and more efficient technology. Advancements in technology have resulted in new products such as high-efficiency chillers and efficient inline pumps coupled to the chiller. Better control valves and automation are available in the market today.

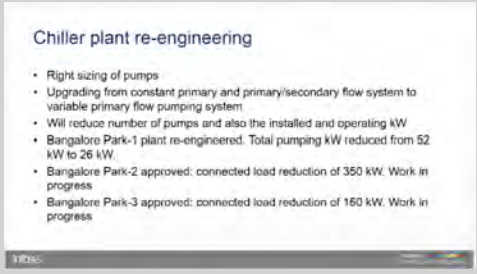
The main advantage of retrofits is that the new equipment can be sized very accurately based on measured operating parameters over a period of time, thereby improving efficiencies greatly. All these deployed at old chiller plants result in a dramatic reduction in the connected load as well as in the energy consumption.

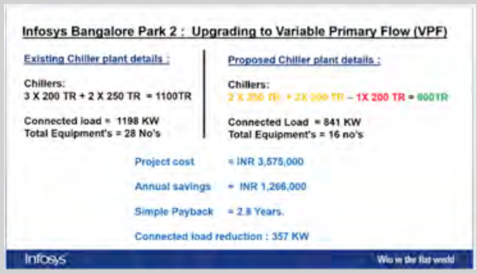
For instance, one of the chiller plants was retrofitted from a primary-secondary chilled water system to a variable primary pumping system. The pumping system was changed from a bank of end-suction pumps to vertical inline pumps coupled to the chiller. The improved design has helped reduce the number of valves from 74 to 25. The reduced pressure drop in the plant room and the right-sizing and selection of efficient pumps resulted in a reduction in the connected load in the plant room by 70%, and energy savings of about 30%.

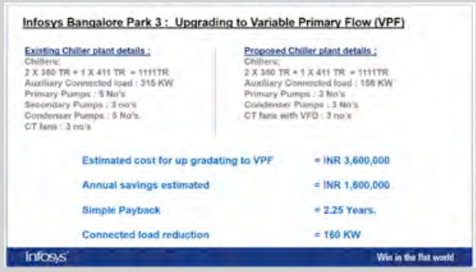
The following graphic shows the number and capacity of the pumps both before and after the retrofit, and, therefore, the connected load reduction through pumping retrofits. Today, after retrofitting 24 chiller plants across these locations, Infosys has achieved a reduction of 7.2 MW in connected load, with savings of 157 million units.



EEM Example : Chiller Optimization







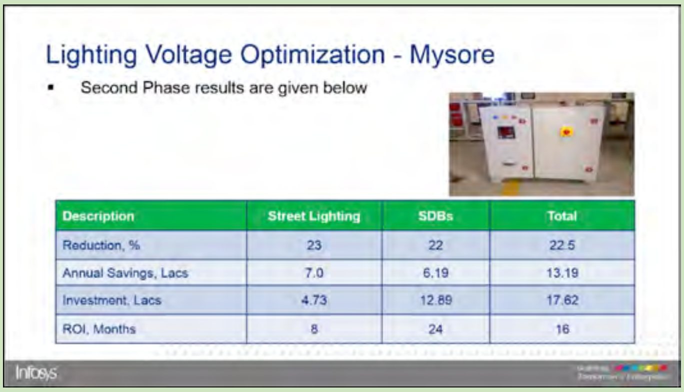

Chiller plant re-engineering proposed

Proposed re-engineering in different locations	
Bangalore park-6	INR 4,000,000
Mysore GEC-1	INR 4,000,000
Mysore GEC-2	INR 4,000,000
Hyderabad Ph-1	INR 4,000,000
Hyderabad Ph-2	INR 4,000,000
Pune Ph-1 (3 plant rooms)	INR 1,000,000
Pune Ph-2 (4 plant rooms)	INR 1,500,000
Chennai (Shols & M-City)	INR 8,000,000
Total Investment	**INR 53,000,000**

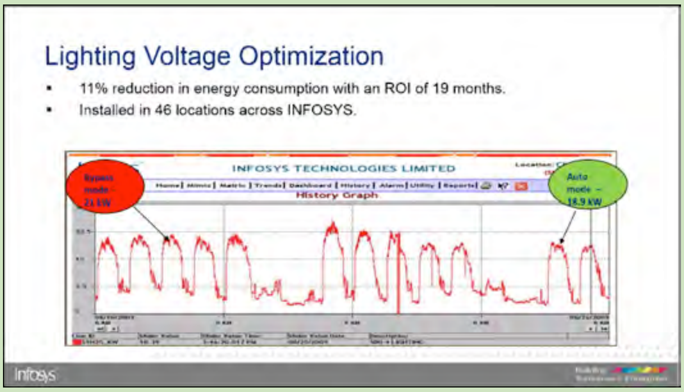
EEM Example : Lighting Voltage Stabilization

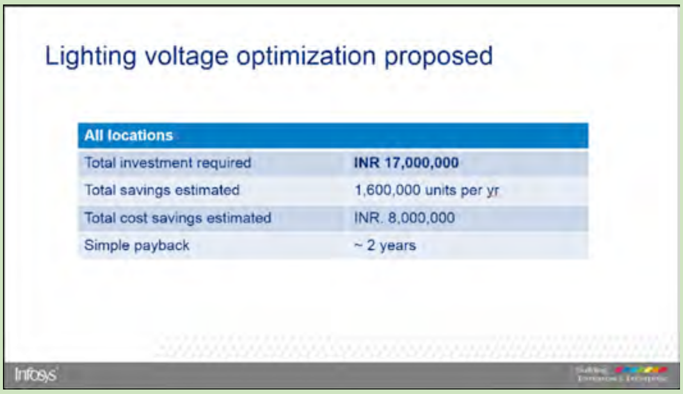
Most of the lamps (fluorescent / CFL) are designed to operate at a voltage range of 205 to 215V, whereas the standard supply voltage is 230V. Sometimes due to fluctuation in power quality, the voltage is more than 240V, increasing the power consumption of the lamp. A lighting voltage optimizer reduces the voltage at the lighting panel to 215V so that power consumption reduces. This is applicable for lamps with variable power ballasts and mainly CFLs and fluorescent lamps. More than 100 of these have been installed at Infosys buildings and at least 10% reduction in energy consumption has been observed on an average.

EEM Example : Voltage Optimization



Description	Street Lighting	SDBs	Total
Reduction, %	23	22	22.5
Annual Savings, Lacs	7.0	6.19	13.19
Investment, Lacs	4.73	12.89	17.62
ROI, Months	8	24	16





All locations	
Total investment required	INR 17,000,000
Total savings estimated	1,600,000 units per yr
Total cost savings estimated	INR. 8,000,000
Simple payback	~ 2 years

EEM Example : Major Retrofit Opportunities (Future)

Top 10 projects for next 3 yrs

	Project
1	Replacement of electrical heaters with Heat pumps in FC,ECC& laundry
2	Vapor absorption machine with exhaust gas of DG sets
3	Solar based hot water driven chiller
4	Replacement of diesel fired boilers with Solar based steam system
5	Auto tube cleaning system for chillers (elimination of chemical use)
6	Use of STP treated water for cooling towers
7	AHU integration with plant manager
8	Building level BMS retrofits
9	Solar PV on roof tops – 8 MW
10	AHU old fans replacement with high efficient EC fans

2.4 Implementation

1. Steps for Implementation Stage	4. Measurement & Verification (M & V)
2. Prioritize EEMs & Recruit Key Ecosystem Partners	5. Results & Feedback
3. Project Execution	

With all vision, strategies and planning complete, projects identified and business cases developed and most important, management approval with budget and resources, it is time to execute and **implement** the projects.

There is a need to have executive management support very similar to Stages (Vision and Goal.) and Stage 2 (Planning) for the (3) Implementation stage. Such an approach should be conducted on an annual basis.

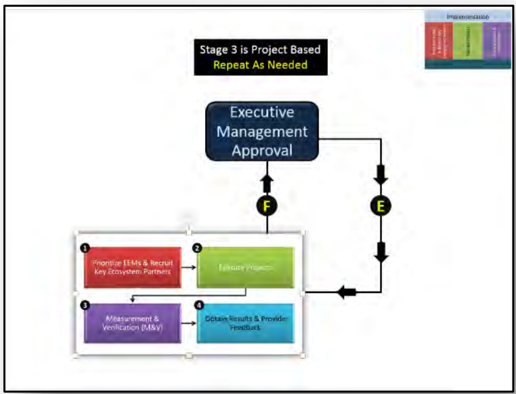


Figure 5.1 : Steps in the Implement Stage

2.4.1 Prioritize EEMs & Recruit Key Ecosystem Partners

The Energy Team (Chapter 4) in place needs to first establish which EEMs to consider and the determine which ecosystem partners will complement the overall energy project efforts. Having a grasp of the key stakeholders and their contributions early in the process in terms of the landscape of the ecosystem can be very valuable in the planning of the energy efficiency plan and approach.

2.4.1.1 Prioritize EEMs

Energy managers will prioritize the potential EEMs by analyzing the different evaluations and assessments. The prioritization will be based on the viability of a given EEM, amount of energy being saved and of course the business case. A listing of possible, common EEMs are included in the ToolSet section of the report.

It maybe appropriate to bundle individual EEMs that are less cost-effective with those that are more cost-effective into combined projects in order to generate a more positive return on investment. This hybrid approach may allow the implementation of EEMs with longer payback periods, but enable desired sustainability goals such as water efficiency, renewable energy generation, and greenhouse gas reduction. In many cases, there may be cases wherein the project to be comprised of a single EEM. Facility energy managers could consider retiring inefficient equipment in a faster cycle if replacement results in lower life-cycle costs.

Bundling of EEMs can optimize energy-saving and/or environmental benefits from a project. EEMs in a bundle must be complementary, i.e., an integral part of the project. In many cases, a decision about one EEM will directly affect the scope or type of other EEMs. It is therefore essential to take an integrated systems approach when defining the scope of a building retrofit or other energy-related project. Another benefit of taking a "bundled" approach is that it will allow for the consideration of "environmental, economic and social benefits and costs" in evaluating projects and activities based on lifecycle return on investment.

2.4.1.2 Ecosystem Partners

As one considers the energy efficiency and management of a building, there is typically a robust ecosystem at work which provides a strong support structure to the program. There will be different ecosystem partners at different stages of the program – depending upon which stage the program is in – early, mid or late.

Each Ecosystem partner has a role in the data produced, the data used and the types of metrics needed as illustrated in the table below :

Ecosystem Partner	Data Produced	Use of Data	Examples of Metrics Needed
Tenants	• Energy Consumption data for sub-metered space	• Energy Efficiency & Benchmarking	• EUI by Occupant & Type of Space
Owners	• Energy Consumption data for all spaces incl. Common Areas, Leased Space (if leased) , Building Characteristics	• Energy Efficiency & Benchmarking • Financial Analysis including Risk if Investment	• EUI by Occupant & Type of Space • Cost Impact of Energy Efficient Measures
In-House Energy Team	• Consumption Data, Systems and Technology Inventory • Energy Audit Data • Commissioning	• Accuracy • Testing	• EUI data • Cost Impact • List of Efficiency Measures • Data Validity • Data Reliability • Spatial and Temporal Analysis of Consumption
3rd Party Service Providers (Contractors, Consultants)	• Consumption Data, Systems and Technology Inventory • Energy Audit Data • Commissioning	• Accuracy • Testing • New Business (esp for 3rd Party Providers)	• Data Validity • Data Reliability
Utilities	• Energy Consumption • Overall Energy as an aggregate (multiple sites) • Sub-Metered Spaces	• Infrastructure • Investment • Incentives	• Spatial and Temporal Analysis of Consumption

Ecosystem Partner	Data Produced	Use of Data	Examples of Metrics Needed
Community Groups	• Neighbor Health • Socio-Economic Trends	• Environmental / Sustainability Studies • Policy • Advocacy	• Spatial and Temporal Analysis
Government	• Land Characteristics • Building Characteristics • Energy Characteristics	• Benchmark Rating • Grading System • Policy Design • Incentive Planning	• Energy Performance Prediction • Policy Effectiveness Planning
Lenders / Financial Institutions / ESCO	Underwriting Standards Energy Loan Performance & Risk Analysis	Loan Terms Energy Performance	• Energy Performance Prediction • Retrofit effectiveness

While the above table is pretty much self-explanatory, it provides a backdrop of what kind of data and why an ecosystem partner is needed. For example, if a financial institution or an ESCO (Energy Services Company) makes some investment in energy equipment or retrofit, it will look to make sure that its investment was not only economically viable but also on track in terms of Return on Investment (RoI).

2.4.1.3 Case Study INFOSYS - Ecosystem Partners

The Infosys facilities team is an active stakeholder as they are responsible for all the operations in their buildings – they own most of the facilities they occupy. They are responsible for taking over and maintaining the operations of newer buildings with energy efficient design . For older buildings, they are actively engaged in the execution of retrofits as this involves, informing employees about shut downs, providing support in terms of man power, and supervision of the projects.

The energy consumed is metered, measured, and monitored by an internal facilities (energy) team, which is part of the larger Green Initiatives team. The facilities team also takes goals to reduce energy consumption, and works closely with the Green Initiatives team in deploying various energy efficiency measures.

Infosys has a fairly broad spectrum of 3rd party ecosystem partners. These partners include consultants and service providers related to glass facades, building management (BMS), sound, metering, energy, lighting, electrical & plumbing, water and sewage treatment STP/WTP, and data center to name a few.

- From a building point of view, architects, structural engineers, original equipment manufacturers are engaged for new building designs. HVAC operation and maintenance contractors, facilities management, and transport (logistics) providers are also used extensively especially for exiting facilities.
- Utilities partners include health, safety and environmental (HSE) officers, facilities team, landscaping consultants, lift operators, food vendors, hospitality contractors.

- Community group partners include employee volunteer programs, employee run eco-groups, and non-governmental organizations (NGO) who partner with Infosys for various issues or employee run programs.
- Infosys also engages with the government at a local (city), state (provincial) and central (federal) level for policy design, licensing, audits, and incentive planning.

2.4.2 Project Execution

The implementation of an energy efficiency project like very similar to common capital improvement or construction projects. The basic steps (all of which are necessary for a successful implementation) are :

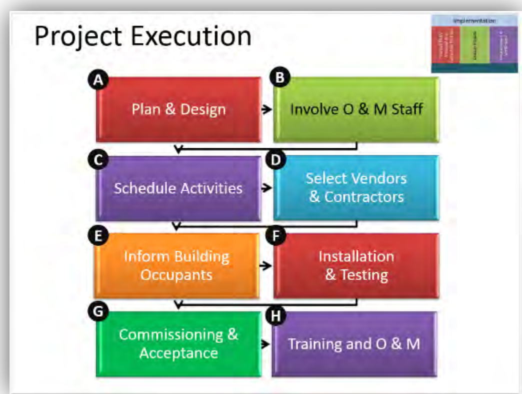


Figure 5.2 : Project Execution

2.4.2.1 Plan and Design

A detailed plan which includes a complete list of equipment and performance specifications is essential. Such a plan should only be prepared by knowledgeable and competent personnel who understand the proposed equipment, the existing building and building systems, and construction and installation issues . This has several advantages – it not only increases the odds that the desired results will be achieved, but that the work will occur in a seamless and smooth manner. Potential contractors and vendors must know and understand what the expectations are for the resulting enhanced system.

2.4.2.2 Involve Operations and Maintenance Staff

The building maintenance and operating staff are essential to the success of the project and should be part of the planning process from the very beginning. Energy savings criteria and ideas should come from these staff members since they tend to see problems on a daily basis as part of their job function.

2.4.2.3 Schedule Activities

Since the installation of an EEM project is usually a retrofit of one or more building systems, it may require that some parts of the building to be impacted for a period of time, possibly disrupting normal operations. Disruptions can be minimized and their impacts reduced by careful attention to scheduling of the different planned activities. Disruptive portions of the work may be scheduled to coincide with normal, periodic shutdowns such as weekends and public holidays.

2.4.2.4 Select Vendors and Contractors

When selecting vendors, suppliers and contractors, the lowest bid, while important, should not be the sole criteria. Discussion on a green procurement strategy earlier in this toolkit clearly outlines the need to balance the selection criteria. The successful bidder/proposer must not only provide details on the equipment, technical specifications but also a warranty on the installation and expected performance levels. Consideration to the ability of the vendors and contractors to provide follow on support, post installation and commissioning is essential. Obtaining and contacting references from potential vendors/contractors is strongly recommended. Taking the time to interview the contractor and key support personnel who will be designing, installing and commissioning the EEMs is a valuable exercise.

2.4.2.5 Informing Building Occupants

After the detailed plan is prepared, the activities scheduled and the vendors / contractors are on board, an occupant communication plan should be prepared and executed to minimize any potential lost productivity. This plan should make sure that that building occupants know and are prepared for any potential disruptions from noise, system operation and other distractions that will occur during the project implementation phase.

2.4.2.6 Installation and Testing

Normal installation techniques can apply, following traditional protocols followed in the building energy related industry – HVAC, Lighting, Electrical etc. These maybe customized to depending upon the situation. Testing and start-up allows the manager to determine the project's compliance with the full and complete performance specification prepared in the design phase. Avoid potential disagreements over who is responsible for operating problems between the different parties involved by making one of these parties contractually responsible for the proper operation of the systems.

2.4.2.7 Commissioning/Acceptance/ Continuous Commissioning

Commissioning involves making sure that the systems implemented are indeed functioning as they were intended or designed for. This topic is discussed in greater detail in a following section.

At the end of the implementation step, the project is commissioned. In the case of EEMs being implemented, commissioning (or re-commissioning in the case of retrofits) is the process of validating and verifying, that the different building subsystems such as HVAC, Lighting and Electrical have achieved the project requirements as intended by the EEMs implemented.

Continuous commissioning is an on-going, whole building approach to prevent persistent operational problems and optimize energy use in existing commercial and institutional buildings and physical plants. Throughout the life-cycle of the project, continuous commissioning accomplishes the following:

- Identifies maintenance issues,
- Corrects identified operating problems,
- Improves building thermal comfort and indoor air quality,
- Minimizes building energy consumption and cost, and

- Provides knowledge-based and hands-on operations and maintenance training to in-house facility management staff.

2.4.2.8 Training and O & M

The facility staff must not only know how to properly maintain and operate it, they must be motivated to do so through an understanding of the system's benefits. A frequent complaint by the building operations and maintenance staff is that the new or retrofitted system requires more technical attention than anticipated. Unless the equipment is regularly checked and maintained, many of the expected benefits can be lost.

This requires that the staff be trained appropriately.

The potential benefits of the system will only be realized fully if the facility staff are trained properly to take advantage of any new EEM measures. The best opportunity for that training is often during the programming development phase. Moreover, facility staff will be able to develop a much better understanding of the system and its capabilities than from a typical training course demonstration.

The energy manager should prepare and execute against "a plan for appropriate operations, maintenance, and repair of the equipment and the appropriate EEMs". The O&M plan may include: timelines, budget and cost estimates, work plan, staffing plan, quality assurance plan, safety and security plan, resource allocation plan, and management control plan for the system, hardware, and equipment upon the completion of the commissioning process.

Following the commissioning and startup of the new system, there will be a need to find a vendor or contractor to provide follow on support for the operations and maintenance phase. It is important to select a vendor with a good reputation for prompt service and an ongoing commitment to the installed hardware and software. This is often the original equipment manufacturer or its local representative but could be an independent consulting outfit.

2.4.2.9 Case Study INFOSYS : EEM Prioritization & Project Execution

The following prioritization and work process flow was followed by the Infosys team :

1. **No cost measures**: Once metering was installed across the campuses, the energy team were able to clearly see the operational schedules of different buildings and systems. The first set of measures were the no-cost measures, which included standardizing of operational schedules for different locations, improvement in operational sequence for equipments particularly in air conditioning systems. These were the low hanging fruits and did not require any capital investment. The savings were clearly visible and got all the stakeholders excited about energy savings, and helped to get a lot of confidence with the senior management. It also paved the way for investments in further efficiency measures.

2. **Low cost measures**: This was the second step, which included replacing small equipment like pumps, installing thermostats, timers for electrical panels to schedule the major equipment on/off, etc. This gave the second level of energy savings in the buildings.

3. **Major retrofits**: These required redesigning the air conditioning plant, replacing redundant UPS from buildings with high efficiency modular UPS systems. These measures required major investments, and the energy savings were very significant, often leading to a payback

of less than 3 years. The major retrofits in air conditioning have helped reduce the electrical connected load by more than 10 MW across the campuses.

2.4.3 Measurement and Verification (M&V)

2.4.3.1 What is M & V

Measurement and Verification (M&V) is a process of quantifying energy consumption before and after an energy conservation measure is implemented in order to verify and report on the level of savings actually achieved. Lord Kelvin has said "If you cannot measure it, you cannot improve it." This definitely applies to energy in buildings. The only way to really gage the actual energy savings of retrofits is to measure and verify the savings before and after the retrofits.

M &V is the process of determining savings from an energy management project or an ECM. It includes data collection as well as the monitoring and analysis associated with the verification of savings. Energy savings cannot be directly measured, since these savings represent the absence of prior energy usage, and instead these energy savings can be estimated by comparing energy use before and after implementation of a project or an ECM.

If building owners implement M & V, they will learn where the energy efficiency bottlenecks are in their buildings and can then take appropriate remedial measures. This can then be validated or verified using the same M & V gear installed originally. A detailed Energy M&V plan for existing building retrofits is therefore critical for efficient building operations and for confirming projected energy savings from implemented retrofits.

2.4.3.2 Calculating Energy Savings

Project follow-up must include an appropriate level of measurement and verification (M&V) to determine that the energy savings derived from completed projects or ECMs can be verified with a certain degree of confidence.

The energy savings attributable to the project can best be described using the following equation:

Energy Savings = (Baseline Energy Use) ± (Adjustments) - (Post Installation Energy Use)

- The baseline energy use is the energy consumed before the implementation of the energy conservation initiative.
- Post-installation energy use, sometimes referred to as “performance period” or “reporting period” energy use, is the energy consumption after the project or program is implemented.

There are many standards based approaches to Energy M & V, including a draft ISO standard ISO17741 (prepared by ISO TC257 WG3) looks at energy savings at a scale whose scope is defined in terms of physical systems (energy using systems or facilities). Its purpose is to establish a set of general rules for quantification, measurement (or monitoring) and verification of energy savings of projects. Many other standards exist as well such as the Efficiency Value Organization (EVO www.evo-world. org) as part of the International Performance for Measurement and Verification Portal (IPMVP).

2.4.3.3 M & V Categories

Broadly, M&V options are divided into two general categories:

1) **Retrofit Isolation** - looking only at the affected equipment or system independent of the rest of the facility
2) **Whole Facility** - consider the total energy use and de-emphasize specific equipment or EEM performance.

EVO has proposed 3 options - Options A and B are retrofit isolation methods; Option C is a whole facility method.

Option A : Retrofit Isolation with Key Parameter Measurement

M&V Option A is based on a combination of measured and estimated factors when significant variations in factors are not expected over time. Measurements are spot or short-term and are taken at the component or system level, during both the baseline and post-installation phases. Measurements must include the key performance parameter(s) which define the energy use of the EEM.

Option B : Retrofit Isolation with All Parameter Measurement

M&V Option B is used when significant variations in factors affecting energy consumption are expected over time. This option isolates the performance of an ECM and verifies actual achieved energy savings using long-term or permanently installed metering or monitoring systems.

Option C : Utility Data Analysis

Option C determines energy savings at the whole building level and is applied to projects in which the individual effect of the ECMs cannot be accurately assessed by measuring the before- and-after energy use by using any of the retrofit isolation methods.

2.4.3.4 Case Study INFOSYS : M & V

Measurement and verification has played a vital role in the evaluation and management of new technologies, energy conservation measures at Infosys, for both new and existing buildings. At Infosys, the energy team measures energy for all the energy consuming assets in a building. This energy is measured in real time as well as on cumulative basis. Energy usage in a typical Infosys building can be categorized into HVAC, lighting, computing, and miscellaneous. When it comes to evaluating operations, new technologies, or identifying energy saving opportunity, measuring only the input energy, is not sufficient. The team measures the system output, so that they have the equipment/system efficiency to evaluate systems, and to take informed decisions.

For all the Infosys buildings, energy consumption of all the HVAC equipment/systems in the building along with their outputs is measured. For example, they measure energy consumed as well as tonnage (TR) produced by chillers and balance of plant to establish chiller level as well as plant level efficiencies. These efficiency numbers are used to continuously verify design vs. actual performance and review operations. With respect to lighting and computing energy, lighting and computing (PCs) consumption are measured at a very granular level.

Infosys has a sophisticated floor-wise energy consumption numbers and use this data to identify the number of lights and computers operating in every floor, every wing in the building. This data helps us establish efficiency of day lighting design and its operation in building, as well as to identify and reduce wastage.

M&V in Infosys buildings help the energy team perform advanced diagnostics. They use peak energy data to again verify estimates that were made at the time of design vs. actual peak performance. This data using M&V has helped them better design their new buildings. For example, using best designs with M&V they have been able to reduce our peak design watt/sqft from 6.5 watt/sqft to 3.5 watt/sqft. M&V allows for substantial savings in first cost as well along with operating cost.

They have also extended knowhow on M&V for energy to water measurement in order to improve effectiveness of water conservation strategies.

2.4.4 Results & Feedback

Evaluating progress includes formal review of both energy use data and the activities carried out as part of the action plan as compared to the established performance goals. These are many times used in a formal review process, for example presentations to the executive management or board to not only report progress but also to create new action plans, identify best practices, and set new performance goals. Some of the impacts of sharing results include:

- Measure the effectiveness of current or ongoing projects and programs
- Make informed decisions about potential upcoming energy projects
- Reward individuals and teams for accomplishments
- Document non-quantifiable benefits that can be leveraged for future initiatives

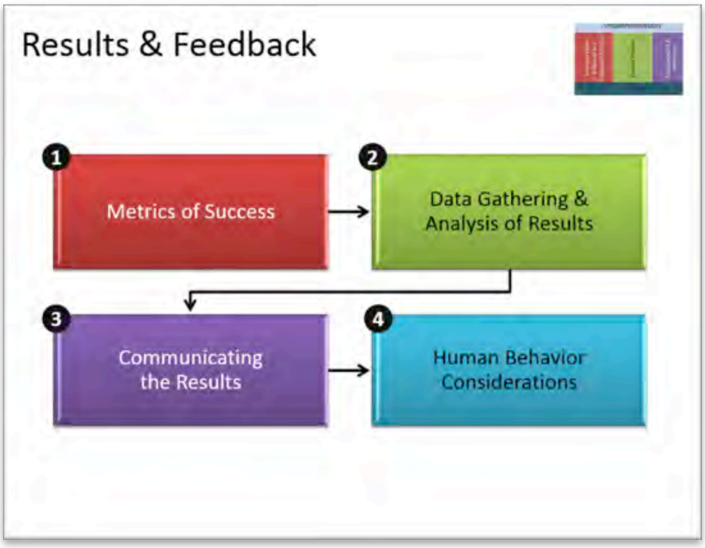


Figure 5.3 : Results & Feedback

2.4.4.1 Metrics of Success

While aggressive goals to save energy or achieve higher energy efficiency levels are eseential, what is equally important is establishing some "metrics" for success, so that the organization and management know that they have (under or over) achieved those goals. If these goals are the best expression of what an organization has set out to manage their energy usage, the first step is to convert those goals into metrics which can be measured and tracked.

As an example, consider this goal statement from Executive Order 13423, (2007) *Strengthening Federal Environmental, Energy, and Transportation Management* , targeted at federal agencies - *improve energy efficiency and reduce greenhouse gas emissions of the agency, through reduction of energy intensity by (i) 3 percent annually through the end of fiscal year 2015, or (ii) 30 percent by the end of fiscal year 2015, relative to the baseline of the agency's energy use in fiscal year 2003;*

This goal clearly states the key measurement of interest (energy efficiency and green house gas emissions) and provides target levels and timeframes (3 % annually) or 30 % by 2015, as well as a baseline year (2003) as a reference. However, this is still a goal and needs to be converted to a metric of sorts.

If data regarding total energy consumption and production volume were available for a particular facility, the following sample performance metric definition could be used:

- The baseline energy consumption and greenhouse gas emissions (GHG) for 2003 will be determined using consumption data from electricity and natural gas utility bills for the entire facility (in units of MBTU).
- Energy efficiency measures will be defined and implemented and on an annual basis, energy consumption and GHG emissions measured and the improvement in terms of efficiency calculated.
- Metering shall be installed on all electric and natural gas service points to measure total facility energy consumption. The metering data collected will be converted to MBTU and summed on a monthly basis. These monthly values shall be aggregated into an annual sum for reporting purposes.
- At the end of each year, the energy consumption and GHG data described in items 1,2, and 3 will be combined to generate the energy consumption performance and efficiency metric.
- This metric will be combined with others into the annual energy management performance report and presented to the executive team for the agency.

What the above list has done is to convert the goal set out by the Executive Order 13423 and into a performance metric definition. This provides the foundation required to determine what data to collect, how often to collect it and how to present it along with the key assumptions made so that everyone involved understands exactly what is being measured.

While the above example is pretty simple and is at the highest level – i.e. only an annual summary performance metric it can always be taken to the next level of granularity and be further expanded to selectively provide the more details that an energy manager would need to investigate deviations from the target goal and help keep the energy management plan on track.

2.4.4.2 Gathering of Data

The next step is to determine what data to collect in order to achieve the performance metrics discussed in the previous section. Most energy information systems can generate a very large volume of data but such large datasets may not be needed to support defined performance metrics.

Types of data :

- ***Static data** such as facility floor space and equipment ratings.* Typically part of an initial energy audit and used to normalize measurements for benchmark comparisons.
- ***Dynamic data** such as energy consumption, external temperature and production volume.* This is an ongoing data measurement exercise where data needs to be collected at regular intervals and processed to map against desired performance metrics.

The dynamic data sets typically are more expensive to acquire and process than the static data.

Common Sources of data

- *Utility Bills.* Typically energy consumption data, billing data and load profile data.
- *"Shadow" Metering.* A separate meter can be installed at the utility service point to "shadow" the utility meter – especially if the utility meter data is not accessible.

- *Sub-meters M*eters on major loads or points within an energy distribution system.
- *Existing Automation Systems.* Collect data from the BMS / BAS systems which have transducers and sensors across a variety of equipment.
- *Temperature data* from *p*ublic sources, live, online sources and local measurements.

Applying Data Collection to Metrics

It is perhaps better to discuss the data collection in relation the Executive Order and associated Performance Metrics outlined in the previous section.

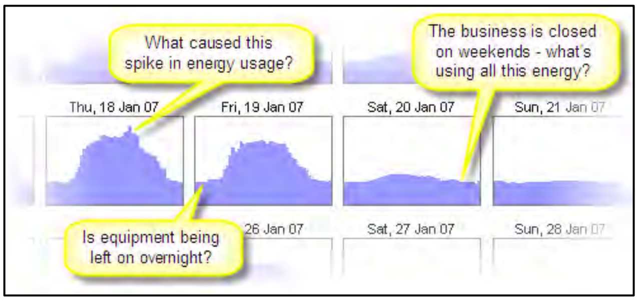
- **Shadow meters** shall be installed at both the electricity and natural gas service entrance points. The electric meter capture electrical consumption (in kWh) at hourly intervals. The gas meter shall capture gas consumption (in cubic feet) at hourly intervals. This data will be uploaded to a central database at least once per day.
- **Electrical power meters** shall be installed on the HVAC / Chiller Plant circuits to record at hourly intervals. This data will be uploaded to a central database at least once per day.
- **Time synchronization** between all energy consumption data shall be within 1 minute or less. This synchronization is required in order to track changes in energy consumption consistently across the overall building.
- **Data Aggregration** . All hourly data will be aggregated to daily totals
- **Data Backup** will occur on a daily basis, and older data will be archived. At all times a 3 year rolling window of data shall be made available.

The above list of specifications mirrors the performance metrics which help ensure the overarching performance goal is met. It provides details about what kind of data is being collected, how often it will be collected and how it will be managed.

2.4.4.3 Data Analysis & Tracking Performance

In the last few sections, goals have been revised in the form of performance metrics and appropriate data collection approaches discussed to support those metrics. The final step of this journey is to analyse and track the energy performance of the buildings.

Once the data has been collected, appropriate analysis needs to be done. The analysis will provide energy intelligence by harvesting the energy consumption data and processing the data. Meaningful information can be derived relating to energy consumption, equipment performance and primary utilities such as electricity or gas. The analysis will help identify opportunities for improvement in operations, occupancy habits, electrical systems, distribution systems, building envelope and mechanical systems.



This will enable the organization to build new energy conservation propositions, improve operational performance and possibly develop new streams of cost avoidance / energy savings especially in times of economic frugality.

Energy managers can only start to ***save*** energy when they clearly ***see*** how it's being used and there is no better way than to present the information in a visually intuitive and user friendly manner. A big part of the analysis is visualization – which will help answer the following questions in a quick to understand manner :

- When and where energy is being wasted
- How much energy is being wasted
- Progress made in reducing energy consumption

Visually analyzing the energy-consumption data helps determine a starting point for the energy savings approach, the steps and how to monitor ongoing progress. It creates the core of all serious energy-saving efforts. Energy dashboards similar to those shown [28] (NREL) the energy manager will be able have concise views of what is happening in the building.

This information can be a general indication of energy performance via "high level overviews" or "detailed drill downs" down to specific equipment or data behavioral patterns. The high level overview data is of great value since it give an overall indication of performance and if there is an anomaly, deeper drill down can be immediately studied to establish the cause and effects of such deviations.

These dashboards can be developed with varying degrees of detail – depending upon the audience viewing them. Key stakeholders may need to only see an overall energy management progress, but the core energy team will need the ability to see fairly detailed levels of information.

2.4.4.4 Communicating the Results

An energy efficiency program can be viewed as a change process. Communication is therefore critical to help impacted stakeholders, especially employees and management, understand what is being done, why it is being done, how they can contribute and how they might benefit from the process. A communication plan helps to communicate with, and engage, with a broad group of stakeholders about the overall energy efficiency journey. The effectiveness of such a major program and of ongoing attention to energy management ultimately depends on the level of support, enthusiasm and interest of key people within your organization.

- People need to understand 'what's in it for them'. This will vary according to the experience of the target audience and their areas of activity.
- Involvement of relevant people is a critical to an energy program so that different perspectives are gained and input to the program is broad.
- The communication plan is concerned with engaging people throughout the energy efficiency process. It is typically prepared by the person responsible for developing the project plan, but others with communications expertise within the organization could also develop the plan.
- Employees could be encouraged to participate in their own ways.
- Potential communications tools may include the following :
    - Meetings – one-on-one or in small groups

[28] http://www.nrel.gov/continuum/energy_integration/images/graphic_living_02_large.jpg

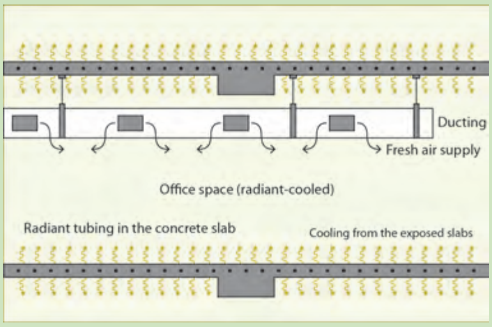
- Briefing notes
- Newsletters – electronic or hard copy
- Intranet
- Posters
- Seminars or workshops
- Public reports.

2.4.4.5 Case Study INFOSYS – Results & Feedback (Radiant Cooling Project)

Radiant cooling as an effective HVAC technology is highly efficient compared to regular air conditioning due to the high water temperatures used, minimized air system and also better quality of thermal comfort. This was implemented in the Infosys campus at Pocharam, Hyderabad and till date is one of the largest experiments in air-conditioning, at Infosys.

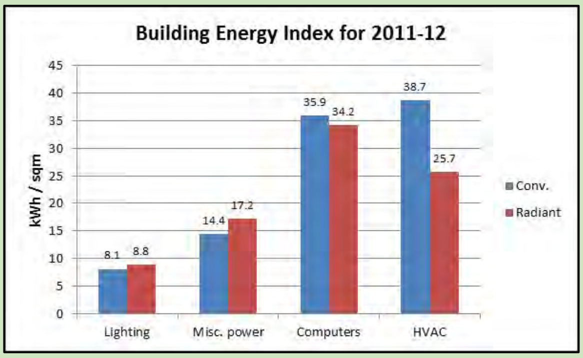
Since the idea was novel to Infosys and non traditional in nature, there was opposition from many stakeholders including HVAC and engineering consultants who were of the opinion that radiant cooling could never work in India. They were very skeptical of the new technology, the associated costs and risks involved. However, the idea was made a reality with the backing of Infosys senior management and Rohan Parikh – Head of Green Initiatives at Infosys.

The building (Software Development Block-1, Pocharam campus, Hyderabad) has a total built-up area of about 24000 sqm. distributed into east and west wings of 11600 sqm. each and a central wing of about 800 sqm. About 85% of the total building area is air-conditioned office area and the total occupancy of the building is about 2500. The most significant feature of the building is that it is split into two symmetric halves. One half is cooled by conventional (but very efficient, surpassing ASHRAE standards [90.1 baseline] by about 30%) air conditioning and the other half by radiant cooling. All parameters in the two halves – area, number of occupants, orientation, envelope and lighting – are similar and therefore the building is ideally suited for comparing two different technologies. To start with, the building has a highly efficient envelope with perfect orientation, double walls with insulation, insulated roof and efficient windows with appropriate shading to maximize natural light in the building and minimize heat ingress.

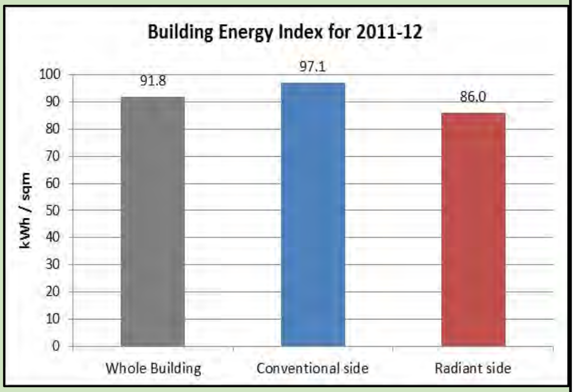


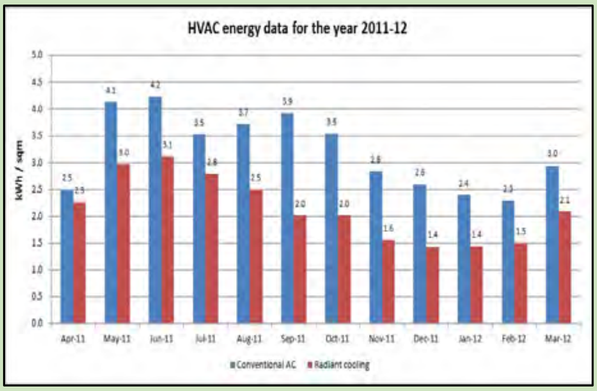
Energy Performance

The design of the building and the building systems was such the building was estimated to be about 40% more efficient than an ASHRAE baseline building. In order to ensure that the data collected was meaningful and comparable, both halves of the building had separate sets of energy meters and were extensively metered for an accurate energy comparison at individual equipment level efficiencies. The building also features a state of the art Building Automation System to monitor and control the operation of the building systems accurately. The building achieved full occupancy in Feb 2011. The comparison results from the energy meters in the building are given below for the period April 2011 to March 2012 as illustrated below.



In 2011-12, the total consumption in the conventional air conditioning system was about 440000 units and in radiant cooling system was about 269000 units. The conventional air-conditioning energy index was recorded to be 38.7 kWh/sqm and the radiant cooling energy index was recorded as 25.7 kWh/sqm. So, the radiant cooling system was 33% lower in energy consumption compared to the conventional air-conditioning system for the period Apr 2011 – Mar 2012.





Costs / RoI

As has been discussed throughout this report, one of the key aspects of implementing new energy efficiency measures is cost – the return on investment between initial capital cost against improvement on efficiency is essential. In the case of the Radiant Cooing system, the following table (all figures in Indian Rupees – INR) illustrates that the capital cost of the 2 different systems were essentially the same (within 1 % of one another), yet the energy efficiency (translates into operational costs) were 33 % better for radiant cooling compared to the conventional system .

	Conventional system	**Radiant system**
Chiller	3145200	3145200
Cooling tower	1306400	1306400
HVAC low side works	22839000	15310000
AHUs, DOAS, HRW	5118200	2878900
Radiant piping, accessories, installation, etc.	0	9075800
Building Automation System incl. submetering	6184000	6584000
Total cost (INR)	38592600	38300300
Area (sqm.)	11600	11600

INR/sqm	**3327**	**3302**

2.4.5 Presentation to Executive Management

After successful execution of an EEM project, it is important to provide specific results to the executive management – (1) to showcase the success and the savings achieved (2)to compare what was estimated and predicted against what was really achieved and finally (3) to get approval for the next set of projects based on this success.

Figure 5.4 : Presentation to Executive Management

2.5 Human Behavior Considerations

"People, not machines, make the decisions that affect energy use. Insight into the human dimension of energy use is key to better understanding future energy trends and how to act effectively to manage them."[29]

2.5.1 Behavior as an Energy Savings Opportunity

One key opportunity often not considered when looking at potential energy savings is from changing occupants' behavior. Human behavior characteristics need to be recognized when developing approaches for reducing energy consumption, since owners, operators, and occupants of buildings are ultimately the ones who make decisions about how energy is used and conserved. Behavior change by facility occupants can contribute significantly to either the success or failure of an energy efficiency project. Human behavior can affect energy productivity in commercial buildings both through occupant behavior and waste as well as via decisions on equipment and building improvements. Such behavior typically arises from a change in energy-consuming activity for example turning lights out and regulating building temperature by adjusting a thermostat setting.

Energy use continues to outpace any gains made from efficiency improvements (the efficiency paradox). Human behavior patterns suggest that people do have the ability of people to adapt and make changes in energy consumption, but the circumstances are important. In a residential environment for example, the individual pays his or her energy bills and so may be more frugal. The same individual may react differently from an office setting where the employer pays for the bills.

Some examples of commonly used mechanisms that which have been shown to influence human behavior include building energy use feedback and benchmarking, social norms and marketing, customer tips and assistance, and financial incentives.

2.5.2 Behavior Change Programs

Behavioral-based energy-efficiency (BBEE) [30] programs use the science of behavior change to encourage energy efficiency. They go beyond traditional utility programs focused on encouraging adoption of energy-efficient technology, typically through financial rebates, to use techniques that have been demonstrated to motivate changes in behavior. Behavioral-based efforts are growing , and promise to expand "both the breadth and depth of energy-efficiency activity."

Some behavior change program mechanisms and components include (not an all inclusive list):

- energy-consumption feedback
- building energy use benchmarking
- commissioning and building energy management,
- energy-reduction commitments, and

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[29] Schipper and Meyers, Energy Efficiency and Human Activity, Cambridge: Cambridge University Press, 1993.

[30] http://www.bpa.gov/energy/n/behavior.cfm

2.5.2.1 Energy Consumption Feedback

Energy-use feedback mechanisms are valuable. They can show the users how much energy they have consumed and how the usage has changed. Such feedback in a corporate environment could be presented via dashboards, email or web based applications. Informational displays across the building in common areas will also reiterate the messaging. Competitions could be conducted across different departments. The frequency of information updating may influence impact and can be augmented with comparisons, advice, online energy-audit tools, and even by real-time information collected using smart meters.

2.5.2.2 Building Energy Use Benchmarking

Energy use benchmarking in commercial buildings has been discussed earlier in this toolkit. It has a human behavior element in that tracking energy use and comparing it to comparable buildings motivates owners and managers to examine their energy waste and seek savings.

2.5.2.3 Commissioning and Building Energy Management

Many commercial buildings are complex systems with multiple sub-systems and even if they are all designed well, they must be tuned and maintained to function properly. Commissioning ensures a new building works as designed and that the operations staff is trained to manage it. Recommissioning is necessary to keep a building operating well. Trained building energy managers with effective building operations and maintenance procedures are as important as capital retrofits in reducing energy use.

2.5.2.4 Commitments and Goal Setting

Expressing commitment to take action can influence behavioral change. It is estimated that up to 10% energy savings can be achieved from commitments made commercial customers. Goal setting has also been shown to be effective. At a corporate level, sustainability goals can drive behavior throughout the organization.

2.6 Continuous Process

As discussed throughout this report, the overall step by step approach is a continuing cycle. The overall process is a journey and should be considered as such.

After successful implementation of energy efficiency programs, the corporation can start to do a local cycle in the implementation phase by going down the list of EEM projects already established. In addition, they can take a hard look at developing revised set of goals.

3 Toolsets

3.1 Sample Vision, Policy & Strategy

3.1.1 Sample Energy Vision[31]

- XYZ Company will lead the market in environmentally-conscious buildings portfolio by pushing the frontiers of sustainable real estate.
- We will continuously advance the design, construction and management of our buildings to achieve greater sustainable and energy efficient building performance.
- We will not only reduce global carbon emissions by advancing clean energy generation, energy management and energy conservation in our buildings portfolio but we will also adopt other aspects of sustainability in our corporate practices and strategic endeavors.

3.1.2 Sample Energy Policy[32]

3.1.2.1 Part A – Goals & Objectives

Our long and medium-term corporate goals are:

- Commit organizational resources to energy management
- Reduce our energy costs
- Give high priority to energy efficiency investments
- Consider life-cycle energy costs for all new projects
- Minimize CO_2 emissions
- Minimize environmental impact
- Where possible, to use energy from sustainable sources.

Our short-term objectives are:

- Publish a corporate energy policy
- Reduce environmental impact of fuels used by reducing our emissions of *a* tonnes of CO_2 by *x*% over *y* years
- Reduce consumption of energy by *x* % of *z* units of energy delivered over (say) *y* years
- Reduce energy consumption to typical/good practice benchmark levels within *y* years
- Achieve accreditation under the Energy Efficiency Accreditation Scheme
- Achieve the emissions reduction target set in our climate change agreement
- Implement a regular program of energy audits
- Set and publish performance improvement targets
- Report performance changes and improvements annually
- Increase staff awareness
- Nominate employees to act as departmental energy champions
- Seek competitive tenders for gas and electricity supplies
- Identify all cost-effective energy efficiency measures
- Establish a monitoring and targeting system
- Provide regular management reports on costs and consumption
- Establish a budget for investing in energy efficiency
- Specify energy efficient design of new buildings, and procure energy efficient plant and equipment.

[31] http://www.related.com/our-company/corporateinfo/20/Vision-and-Principles
[32] http://www.carbontrust.com/media/13187/ctg054_energy_management.pdf

3.1.2.2 Part B – Commitment

We are committed to:

- Purchasing energy at the most cost-effective price
- Increasing energy efficiency in terms of, for example, energy consumed per unit of production (for industry)
- Reducing CO_2 emissions
- Investing in new technology where this meets investment criteria (including renewable energy sources)
- Considering life cycle energy costs when procuring new projects
- Purchasing energy-efficient plant and equipment (including office equipment)
- Reducing environmental emissions associated with travel (including employee travel to work, business travel and distribution of goods)
- Entering into a climate change agreement via our trade association
- Investing in energy-saving technologies that are eligible for enhanced capital allowances.
- Addressing energy efficiency in all areas of our business including the list below.

Management issues

- Define roles and responsibilities for energy
- Educate and raise awareness among staff
- Encourage continual professional development (CPD) f staff involved in energy
- Establish clear reporting procedures
- Publicize our performance and report areas for improvement

Procurement issues

- Procure equipment with low energy ratings
- Consider life-cycle energy costs for new projects and modifications to existing plant
- Establish technical guidelines for new projects and refurbishment

Financial issues

- Establish ownership of energy costs at departmental level
- Establish ownership for invoice verification

Technical issues

- Establish procedures for operation of plant and equipment.

We will improve on past performance: Over the past *y* years:

- Our energy costs have increased/decreased by *x*%
- Our energy efficiency has increased/decreased by *x*%
- Our emissions of CO_2 have increased/decreased by *x*%
- Our consumption of fossil fuels has increased/decreased by *x*%
- Our consumption of renewable energy has increased/decreased by *x*%
- Our investment in clean, energy-efficient technologies has increased/decreased by *x*%.
- We are committed to reversing/reinforcing/accelerating this trend/these trends through a strategic action plan which will be reviewed for progress and updated each year.

3.1.3 Sample Energy Strategy

Organize Management Resources

Once commitment from senior management is achieved, establish a clear accountability for energy management with appropriate allocation of financial and staffing resources as well as reporting procedures.

Appoint an Energy Manager

Appoint a senior staff member as the energy manager. This person is responsible for the overall coordination of the strategy and reports directly to senior management. The energy manager may come from any department, such as technology, accounting, purchasing, or administration. The overriding factor is that the energy manager must be motivated to reduce energy costs.

Establish an Energy Use Monitoring and Reporting system

A system should be established to collect, analyze and report on the organization's energy costs and consumption. A useful way of organizing this data is to use a database or spreadsheet. This is required in order to establish an overview of energy use and related costs. Set up a database to record historical and ongoing energy use and cost information, and produce a summary report of this on a monthly basis. From this information, data trends can be analyzed and tariffs reviewed. You can record information and drawings of buildings, the equipment and systems, and when they operate.

Implement a Staff Awareness and Training Program

A key ingredient to the success of any energy management strategy is to maintain a high level of awareness among staff. It is important to communicate the strategy's plans and report results. Staff may need training from specialists to demonstrate energy saving practices and use of equipment.

Identify Technological Energy Saving Opportunities

An energy audit establishes where and how energy is being used, and potential for energy and cost savings. By understanding the energy use of each process, energy flows can be determined. An audit will include recommendations for actions that result in energy and cost savings. It is important for these recommendations to be endorsed by senior management as key goals to be achieved in the energy management strategy.

Prepare a Detailed Project Implementation Plan based on Audit Findings and Budgets.

Develop a plan of action, based on the results of the energy audit. The targets for energy savings need to relate to specific areas of the organization. The plan should include a project implementation timeline and state any funding and budgetary requirements.

Implement Projects

Implement the projects in order of priority as set out in the action plan. The progress of individual projects will need to be closely monitored to ensure they stay within budget and achieve the energy target within the specified time frame.

Report and Review results

Review energy consumption regularly. Report results/progress to management and staff on a regular basis. This will assist to increase awareness of energy efficiency issues among employees and will encourage an ongoing commitment to the program.

Annual Review

An energy management strategy will be more effective if its results are reviewed annually and the plan of action revised. The review should at least detail actions undertaken during the year and projects and implementation plans for the next twelve months.

3.2 Green Procurement

3.2.1 Example Procurement Policies

Type of Procurement Policy	Description
Life Cycle Cost Analysis (LCCA)	In order to mitigate the debate between initial up from capital cost and operational cost over a products' lifetime, it may be good practice to include a spreadsheet which will estimate the Life Cycle Cost (LCC) Analysis based on the best efficiency levels offered, with the lowest LCC declared the winner. This then allows suppliers to offer the most efficient model/product in terms of both energy and cost model they have and not only the cheapest model meeting the bid specifications. Appropriate verification / certification is likely necessary for such an approach.
Output Based Procurement	Sometimes the type of technology (for example in lighting – metal halide, fluorescent, LED etc.) is less important than the end use service the product provides (for example lumens/m^2). The bid itself may not ask for a given technology, only being concerned with the final end-use. Suppliers can specify the any technology (including proprietary) but also the specific end-use metric. As with the LCCA approach, appropriate testing and certification upon receipt will be needed.
Marketplace	This applies to organizations or consortia who have large buying power. Such organizations can create a marketplace and stimulate the demand for energy efficient products and services. For example, if a group of companies (or a multinational company with multiple sites) ask to implement LEDs for lighting and agree to procure from a given vendor for a project or two and agree to use the same vendor for future projects as an incentive. Such an approach will not only create a marketplace but also will help to bring down costs.
Energy Use Warranties	Typically, product warranties cover basic operational parameters, such as functionality or equipment life. One strategy would be for organizations to ask for an energy-use warranty, whereby suppliers are required to indicate the energy use of a product under given operating conditions.
Performance Based Warranties	Although similar to the Energy Use Warranty, this would provide for an additional lever this would provide is some financial recourse for poor equipment performance. Achieved by creating an escrow account of approximately 10 % of the total fee (similar to what may be done for a defects and liability period) and hold a portion of the final payment for 6 to 12 months to guarantee product performance.
Energy Supply Contracting	Such a model wherein the overall operation and maintenance of a technical energy system (such as HVAC) is outsourced to a contractor who in turn sells the output (e.g., steam, heating/cooling, lighting in terms of joules, cooling per m^2, lighting per m^2 per hour), all at a pre-negotiated price. This is a service option, but can be a versatile and powerful tool to ensure lowered energy costs in a more flexible manner such that the performance risk is undertaken by a 3rd party supplier.
Energy Service Companies (ESCO)	An ESCO contract can range all the way from design through commissioning of energy equipment including the implementation of energy efficient projects, technologies, and equipment to a customer. Typically, such improvements may involve considerable capital cost which is borne by the ESCO (minimizing the capital outlay for the customer) in return for portion of the savings derived from lowered energy use. Such compensation is typically contingent upon demonstrated performance in terms of energy cost savings or other performance measures

3.2.2 Example Green Technical Specification Catalogs & Product Listings

Source	Link
Canada G.I.P.P.E.R.'s Guide to Green Purchasing	http://www.pmac.ca/images/stories/tools_resources_pdf/gipper.pdf
Consortium for EE Specifications	http://www.cee1.org/resrc/specs-main.php3
EU GPP criteria catalogue	http://ec.europa.eu/environment/gpp/eu_gpp_criteria_en.htm
The City of Los Angeles Bureau of Street Lighting LED Street Lights Specifications	http://bsl.lacity.org/
Green EcoLabelling Network	http://www.globalecolabelling.net
Mexico City General Guidelines for the Procurement of Goods with Less Environmental Impact	http://www.sma.df.gob.mx/saa/images/descargas/eventos/curso2011/lineamientos-cv-2011.pdf
City of New York	http://www.nyc.gov/html/mocs/downloads/pdf/epp/nycepp_goods.pdf
City of Portland Buying Green Example Specifications	http://www.portlandonline.com/omf/index.cfm?c=53454&Procura+Criteria
SEMCo Procurement Criteria	http://www.msr.se/en/green_procurement/criteria/
US FEMP Criteria	http://www1.eere.energy.gov/femp/technologies/eep_purchasingspecs.html
Procura+	http://www.procuraplus.org/en/about-procura/procura-manual/
Responsible Purchasing Network	https://www.responsiblepurchasing.org/purchasing_guides/all/

Sometimes, even finding an energy efficient product can be very difficult and also frustrating since it is difficult to find a lot of information in a single location and also for a localized geography. Here is a starting point :

Global Region / Country	Energy Efficient Product Listing
China	• http://www.ccgp.gov.cn/jnhbchaxun • http://www.zycg.gov.cn/home/xygh
United States	• http://www.cee1.org/resrc/qualprod-main.php3 • http://www.ecologo.org/en/certifiedgreenproducts/ • http://ww2.epeat.net/searchoptions.aspx • www.energystar.gov/index.cfm?c=products.pr_find_es_products • http://www.sftool.gov/greenprocurement
Japan	• http://www.gpn.jp/econet

Global Region / Country	Energy Efficient Product Listing
Korea	• http://shop.greenproduct.go.kr
European Union	• www.eu-energystar.org/en/database.shtml
United Kingdom	• http://www.buyingsolutions.gov.uk/aboutus/sustainability/sustainable-solutions/quickwins/

3.3 Building Characteristics

3.3.1 Site & Building Information

- Property Name
- Address / Location
- Site Area
- Brief Description of Site – Trees / Shading / Green Area / Water Bodies etc
- Building Type / Function
- Construction Status – New / Recent / Old
- Age of Building
- Building Orientation
- Weather and Climate
- Average outdoor temperature in summer
- Average outdoor temperature in Winter
- Details on Parking

3.3.2 Detailed Functional Breakdown

- Office
- Commercial / Retail
- Cafeteria
- Data Center / Server Room
- Parking
- Plant Room
- Auditorium / Conference Center
- Laboratories

3.3.3 Details on Physical Areas

- Detailed Floor Plans
- Gross Built Up Floor Area (all areas / space within the building)
- Usable Area
- Lighted Floor Area
- Conditioned (Cooling / Heating) Area
- Non-Conditioned Area
- Roof Area incl. Green Roof Area
- Façade Area including Window to Wall Ratio
- Number of Floors and Area by Floor
- Number of Buildings if a Campus and associated information for each.
- Details on Parking if integral to Building – Number of Cars, Exposed, Basement etc
- M & E Schematics – Plumbing, HVAC and Electrical Drawings

3.3.4 Operational Information

- Typical Daily Operating Hours
- Weekly Operating Hours
- Months in Operation
- Number of Elevators / Escalators & Operating Hours
- Number of Workers / Employees
- Average Indoor Temperature
- 7 Day schedules for HVAC, Lighting including comfort and economy modes

3.3.5 Sample Equipment Inventory

3.3.5.1 HVAC Equipment

- Cooling Systems – List all systems by space /location
- Heating Systems – List all systems by space /location
- Air Distribution – List all systems by space /location
- HVAC Control System / Local or BMS
- Baseboard Heating
- Radiant Floor Heating
- Radiant Cooling
- Chilled Beams
- Boilers
- District Heating and Cooling
- Central Chiller – Water Cooled or Air Cooled
- Constant Air Volume (CAV) Systems
- Variable Air Volume (VAV) Systems
- Evaporative Coolers
- Fan-Coil Units
- Furnaces
- Heat Pumps- Single-Package, Split-System, Packaged Terminal Heat Pumps, and Water Loop Heat Pumps
- Individual Air Conditioner
- Individual Space Heater
- Packaged Unit - Single-Package Rooftop Units and Split Systems
- Packaged Terminal Air Conditioner (PTAC):
- A single-package air-conditioning unit
- Room Air Conditioner
- Cooling Towers
- Economizers
- Pumps
- Building Automation and Control Systems (BACS)

3.3.5.2 Office Equipment & Plug Load

- Desktop computers
- Laptop computers
- Computer Servers
- Monitors – CRT and LCD
- Printers - Inkjet ,Laser
- Fax Machines
- Copiers and Scanners
- Multi-function devices (MFDs)

3.3.5.3 Lighting

- Lamp Fixture Type / Count by Space
- Lamp / Fixture Wattage
- Fluorescent incl. CFL
- Incandescent
- LED
- Outdoor vs. Indoor

3.3.5.4 Elevators & Escalators

- Normal
- Regenerative
- Elevator (Building) Management System

3.4 Financials - Terminology

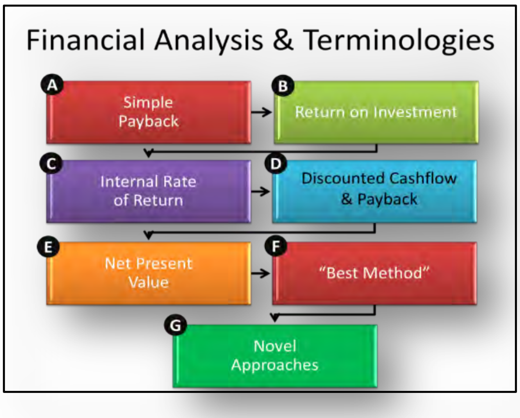

Figure D.1 : Financial Analysis Terminologies

As mentioned in an earlier section, the financial analysis is a critical to any business case. There are multiple types of financial analysis and terminologies. Most energy managers are not familiar with the basic financial terms which will catch the eye of a CFO. This section is to provide an overview and examples of the different financial terms

If the organization chooses to borrow in order to finance the energy efficiency projects, the cost savings need to exceed the cost of interest payments. If the money comes from internal reserves, the cost savings from the energy efficiency project need to exceed the income that could have been earned by having invested the money either in the open market or in a competing project that also offers cost savings or increased revenue.

Organizations typically approach the need to finance energy-efficiency capital improvements in one of two ways: parity competition for capital or capital set-asides. Under parity competition, capital improving the energy efficiency of the firm is evaluated in the same manner as other capital investments. Common methods for parity competition include simple payback, internal rate of return (IRR), return on investment (ROI), and net present value (NPV). In capital set-asides, a percentage of the firm's annual capital improvement budget is reserved exclusively for energy-efficiency projects.

3.4.1 Simple Payback

The simple payback method is defined as the expected time period required to recover the original investment. It divides the cost of a project into the cash inflows (savings) as a result of implementing the energy efficiency project over a given time period. For example, a $5 million project generating $1 million in cost savings revenues per year has a 5-year payback period. Conventional wisdom based on different studies shows that the payback period varies from 1 year to 3 years, with the small firms looking for 1 year and large firms willing to wait for 3 years.

The following are some simple examples.

Consider two hypothetical (and simplistic) scenarios which illustrate the subtle difficulties of choosing between projects. Project A will save $ 50,000 a year for three years, while Project B saves only $ 45,000 per year but will last five years. Both projects cost $ 100,000 to implement.

Project A	**Y 0**	**Y 1**	**Y 2**	**Y 3**	**Y4**	**Y 5**
Cost of project	- $ 100,000					
Savings		$ 50,000	$ 50,000	$ 50,000		
Cash flow	- $ 100,000	$ 50,000	$ 50,000	$ 50,000		
Project B	Y 0	Y 1	Y 2	Y 3	Y4	Y 5
Cost of project	- $ 100,000					
Savings		$ 45,000	$ 45,000	$ 45,000	$ 45,000	$ 45,000
Cash flow	- $ 100,000	$ 45,000	$ 45,000	$ 45,000	$ 45,000	$ 45,000

The simplest and most familiar way to evaluate and express the financial value of such a project is the Simple Payback (SP) calculation.

Divide the project's cost by the annual savings provides the time period wherein the original outlay of $ 100,000 will be recovered.

- Project A has an SP of 100,000/50,000 = 2.0 years
- Project B achieves an SP of 100,000/45,000 = 2.2 years.

Project A appears to be a better deal than Project B. Having said that, this is not the complete story, since Project B has a total return of $ 125,000 over its lifetime (3 years) whereas Project A has a total return on $ 100,000 over its lifetime of 2 years seems preferable. A more powerful indication of the payback would be if one could state that the payback repays its cost every 2 years, that is, the savings are continuous and not limited to a small period of time.

Engineers, in particular, tend to prefer the use of simple payback as the preferred method for evaluating the economic viability of projects, primarily due to its simplicity. However, the method is not popular from flawed from a financial management perspective because it does not account for any savings or benefits beyond the payback period, nor does it take into account the time value of money, inflation and "what if" the money was invested elsewhere - namely that a dollar today is more valuable than a dollar next year.

Another shortcoming of the SP approach is that it has no indication of the absolute value of the proposal. For example, replacing incandescent lamps with compact fluorescent (CFL) lamps would give a really fantastic SP but will only have a negligible impact on the overall carbon footprint.

SP gives us a quick and rough order of magnitude method to compare alternative projects, but most importantly, it is not the preferred or recognized method used for evaluating investment choices in financially-savvy organizations.

3.4.2 Return on Investment (ROI)

The return on investment (ROI) is the ratio of benefits to the costs of a project in terms of the present value.

ROI is a measure of the savings a project delivers for the time period that the project and its measures are in place. It is an improvement over Simple Payback since it accounts for savings that a project will create even after the initial investment has been recovered.

For example in the example above, Project A has an initial investment of $ 100,000 and will result a savings of $ 150,000 over 3 years. Its Simple payback was 2 years, but the ROI will be the total savings over 3 years divided by the initial investment – a value of 1.50.

An ROI above 1.00 indicates that the project benefits outweigh the costs, but an ROI of less than 1.00 indicates that the project's costs exceed the benefits.

Similar to simple payback, the downside of using ROI is that it does not consider the "time value of money". If energy prices increase over time, the ROI figure will be understated. Similarly, if the energy consumption patterns vary, the result will be inaccurate.

3.4.3 Internal Rate of Return (IRR)

The internal rate of return (IRR) is the interest rate corresponding to a zero net present value. This means that it is the discount rate that equalizes the present value of a project's cash inflows to the present value of its expected costs. The benefit of the IRR is that it can easily be compared to the firm's cost of capital or other internal metrics established by the finance department. If the IRR of a project is greater than the organizations' cost of capital, it would indicate that the project would have positive financial impact.

A given project maybe viable at a given discount rate of x % but not at say y %. So the tip over point (that is the discount rate at which it just fails) will be somewhere between x and y %. This tip over point is the IRR. There is no straightforward analytical method of calculating IRR; traditionally it was done by an iterative process involving trial and error and interpolation, or graphically. However, spreadsheet programs provide an IRR function which makes computation much easier.

3.4.4 Discounted Cashflow and Payback

As mentioned in the previous section, one of the shortcomings of the simple payback method is that does not capture the value of continued savings in the future, and also does not illustrate how the proposed project compares with other possible investments. In order to address this, many financial managers use a modified approach known as discounted cash flow (DCF)[33].

In DCF calculations, all the project's current and future costs and savings are aggregated into a single lifetime figure, but including the fact that cash flows in the far term are likely to have less weight than those in the near term.

This is best explained as follows :

If one assumes that one can earn 4 % interest in a bank. If offered a choice of one of three cash prizes on condition that the money is not spent until 5 years hence :

- $ 822 Today
- $ 889 in 1 year
- $ 1000 in 5 years

[33] http://www.carbontrust.com/media/169595/j7896_ctv067_making_the_business_case_for_03.pdf

After 5 years, @ 4 % interest, both the $ 822 and $ 889 also become close to $ 1000 in 4 years. So, all of these prizes are pretty much equivalent. $ 822 is called the "present value" of the $ 1000 and the discount rate is 4 %.

This approach helps to account for the "time value of money" especially in terms of project's cost of capital in calculating the expected cash flows. In the event that the organization needs to borrow capital to execute against the energy efficiency project, there is a need to account for the interest / cost of capital. Cash flows are discounted by the firm's cost of capital.

Discounted payback is calculated by dividing each cash inflow by $(1+k)^t$, where k is the firm's cost of capital and t is the year. Thus, a $5 million project generating $1 million in revenues per year with a 10% cost of capital has a 7.3 year payback period.

3.4.5 Net Present Value (NPV)

The net present value (NPV) of a project can be defined as the sum of cash flows resulting from a project over its anticipated life, discounted by the cost of capital. NPV is preferable to discounted payback because it evaluates the net benefits of a project into current, present day terms over the entire course of the project.

NPV is being advocated as a more appropriate value mechanism[34] for EEMs because it takes into account just how many years a company can expect to get 'paid' by their savings, and discounts it back at market rates of return to arrive at an appropriate value, or cost, of the job. If the cost is more than the NPV, then the decision is clear – it will not be providing a positive financial outcome, so the project should not be performed. The key inputs are the same as figuring out ROI and Payback Period, however the method uses a discount rate to establish the level of return being sought on the 'investment' in an EEM.

The key advantage of NPV is that it allows for an easy decision-rule for accepting projects.

- A positive NPV means that the project has returns exceeding the investment and helps the financials for the organization
- A negative NPV indicates the project loses money,
- A zero NPV means that the project does not affect the position of the organization
- Higher the NPV, better the financial return on that project (an NPV of 150 is preferable over an NPV of 100)

3.4.6 A Realistic Scenario

The earlier examples have been deliberately simplified. In reality, the situation will be much more complex. For example there maybe multiple factors which impact the financials such as :

- Ongoing Running Costs – for example the use of a a heat recover system may need additional pumps and therefore more electrical energy
- Need to account for Maintenance Costs which may vary with time
- Potential Additional Savings in the First year itself (Year 0)
- Varying Energy Prices during timeframe (due to inflation, market dynamics)

[34] https://www.noesisenergy.com/site/noesis-corporate-blog/thorny-problem-how-exactly-do-you-measure-benefits-ecm

- Tax treatments – may vary depending upon country, tax laws and company preferences of accounting

Project	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Initial Cost	$ 10,000					
Maintenance		- $ 500	- $ 750	- $ 1,500	- $ 750	- $ 750
Additional Electrical Power	- $ 100	- $ 250	- $ 300	- $ 360	- $ 432	- $ 518
Savings	$ 2,000	$ 5,000	$ 6,000	$ 7,200	$ 8,640	$ 10,368
Simple Cashflow	-$ 8,100	$ 4,250	$ 4,950	$ 5,340	$ 7,458	$ 9,100
Discount Factor	1.000	0.811	0.657	0.533	0.432	0.350
Discounted CashFlow	- $ 8,100	$ 3,445	$ 3,253	$ 2,845	$ 3,221	$ 3185
Cumulative DCF	-$ 8,100	($4,655)	($1,402)	$1,443	$4,664	$7,849

In the example table above, the following aspects are covered :

- Some early savings in the year of implementation
- Maintenance costs vary, peaking in Year 3
- There are additional electrical energy Costs due to the EEM measure,
- The cost of energy increases at a rate of 20% annually (accounting for inflation)
- The bottom line (savings) stays the same
- Each year's net cashflow – both simple and discounted is estimated.
- The cumulative (discounted cashflow is also presented)

3.4.7 The Best Method ?

In practice, the choice of method does not matter if the different evaluative methods for capital projects derive the same result. And under certain conditions, this is very much possible. For example :

- Payback and IRR will yield equivalent results as long as the IRR is between 0 and 200%.
- NPV, IRR, and ROI will all yield positive results when annual returns are greater than the firm's annual cost of capital.
- NPV, IRR, and ROI will mathematically always result in the same accept/reject conclusions if projects are evaluated *independently*.

However, it should be noted that IRR and NPV will result in conflicting rankings when projects differ in scale (small v. large) and timing of returns (early v. late). Under such a scenario when NPV and IRR may provide conflicting rankings, the use NPV over IRR is recommended because of NPV addresses how income streams from the project are reinvested by the firm. Similarly, NPV is also superior to ROI in evaluating capital projects since it considers the benefits of a project in actual dollar terms rather than as a ratio of return per dollar spent.

The next section on financial tools provides some examples to actually calculate the financial returns, including NPV, removing any need to develop customized spreadsheet based calculations.

3.4.8 Novel Approaches

A compelling topic of discussion among companies and financial theorists is how capital budgeting can give weight to corporate goals in energy efficiency. The financial team in the organization needs to be a little creative in their approach towards capital budgeting in relation to energy efficiency. Here are a few suggestions on such creative, yet financially acceptable approaches:

- Extend payback periods,
- Shadow carbon emission costs
- Use of lower risk levels
- Portfolio Approach

3.4.8.1 Extending Payback Periods

There is a trend to increase the "acceptable" payback period for capital intensive energy efficiency projects. One example is Toyota, which, at a company level, extended the payback period from 5 years to 7 years for capital improvements that increase the energy efficiency of their operations[35] . Such a top down approach, with management blessing, provides incentives for the company to invest in energy efficiency capital projects.

3.4.8.2 Shadow Carbon Emission Costs

One other technique is the concept of a "shadow" carbon emission cost. It is a shadow cost since many countries do not have a "carbon trading" system to charge for carbon emissions. Essentially, what is done is that the carbon emission costs are included in capital budgeting decisions, for example discounting future earnings by an anticipated carbon cost when calculating the NPV of a project. A fixe cost per ton of CO_2 emissions (such as US $ 10/ton) could be used in capital budgeting analysis. The final result is an approach to reward more environmentally conscious capital projects over more polluting projects.

3.4.8.3 Lower Risk Levels

Some organizations have begun to associate energy efficiency improvement projects with a lower risk compared to other types of capital intensive projects. The reason is that projects improving the energy efficiency for a given building or process can be a much safer investments than, for example, expansion into a new project. This would mean that even if the financials are the same between two competing projects, the one with lower risk will prevail and get management support.

3.4.8.4 Portfolio Approach

Similar to the concept of a mutual fund, a concept of "basket of multiple energy efficiency capital projects" can be addressed. This indicates that there could be an overall goal for the group of projects for energy improvement and the risk of getting to that end goal is spread across the multiple projects. For example, if a company establishes a goal to reduce energy consumption by 25% in five years, the typical approach is to find individual projects in a company that annually reduce the energy use by around 5%, given thresholds for payback and ROI. Thus, the basket of projects is maximized, not individual projects for an individual year. There can therefore be a mix of both short and long paybacks across a variety of projects.

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[35] http://www.c2es.org/docUploads/PEW_EnergyEfficiency_FullReport.pdf

3.4.9 Easy to Use Financial Tools

There are many financial tools available to develop a business case. However, only a few of them have been developed with a 'building energy efficiency" lens. It should be cautioned that as one uses common financial tools to determine economic viability, it is important not to use default values of energy prices, people costs or equipment costs. This may skew the results in one direction or the other

The US EPA[36], as part of its Energy Star[37] program has the following (free to use) tools which can be downloaded from their website. Such tools can be used as a first cut analysis to determine the financial viability of a given energy efficiency measure or opportunity. In most cases, these tools will suffice to muster the support of the management team. More detailed analysis then can always be performed as needed. While other calculators do exist, and this report is not endorsing the US EPA tools, they are being provided as a reference that users of this Toolkit can download and try to establish if it meets their needs.

The three calculator tools that the US EPA has developed are :

- Building Upgrade Value Calculator (BUVC)[38]
- Cash Flow Opportunity Calculator (CFO) [39]
- Financial Value Calculator (FVC)[40]

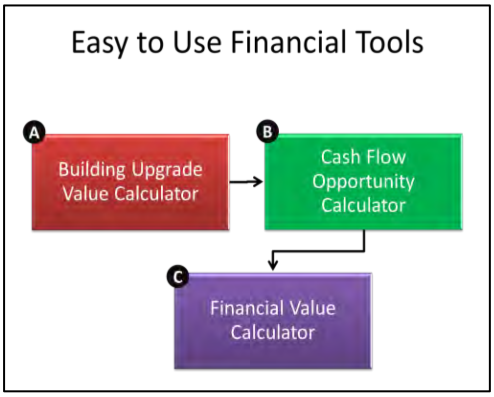

Figure E.1 : Financial Analysis Tools

3.4.9.1 Building Upgrade Value Calculator

The Building Upgrade Value Calculator, developed by the U.S. EPA, is a product of the partnership between Energy Star, BOMA[41] International, and the BOMA Foundation. The calculator tool was

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[36] http://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/find-financing/calculate-returns-energy-efficiency

[37] EPA Energy Star : http://www.energystar.gov/

[38] http://www.energystar.gov/buildings/tools-and-resources/building-upgrade-value-calculator

[39] http://www.energystar.gov/buildings/tools-and-resources/cash-flow-opportunity-calculator-excel

[40] http://www.energystar.gov/buildings/tools-and-resources/financial-value-calculator

[41] BOMA – Building Owners and Managers Association www.boma.org

developed to help property professionals assess the financial value of investments in a property's energy performance. This calculator was developed as part of BOMA's Energy Efficiency Program (BEEP), a series of courses designed to help commercial real estate practitioners improve their buildings' energy efficiency performance.

The Building Upgrade Value Calculator lets you analyze the financial value of efficiency-related capital investments in commercial real estate. The calculations are based on data input by the user, representing scenarios and conditions present at their properties. Required inputs are limited to general characteristics of the building, plus information on the proposed investments in energy efficiency upgrades.Enter information—such as square footage, annual utility bill, the projected cost and savings for each investment, and financing terms—to determine a particular investment's energy and financial benefits. From there, you can either print out a summary report, or automatically generate a customized letter that you can take to your senior management to make the business case and secure funding.

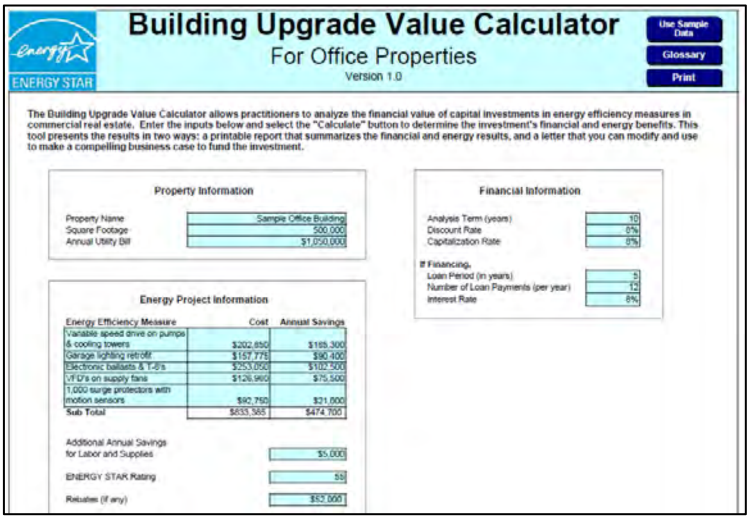
The calculator's analysis includes the following information:

- Net investment
- Reduction in operating expense
- Energy savings
- Return on investment (ROI)
- Internal rate of return (IRR)
- Net present value (NPV)
- Net operating income (NOI)
- Impact on asset value

In addition to the above outputs, the calculator also estimates the impact the proposed changes will have on a property's ENERGY STAR rating. The tool provides two ways to use its calculations: users can save and print a summary of their results, or generate a letter that highlights the financial value for use as part of a capital investment proposal. Because energy efficiency projects generally improve net operating income, the calculator provides strong financial arguments in favor of implementing these projects.

Instructions to download the BUV calculator can be found at the following url :

https://www.energystar.gov/buildings/sites/default/uploads/files/Building%20Upgrade%20Value%20Calculator%20for%20Office%20Buildings.pdf



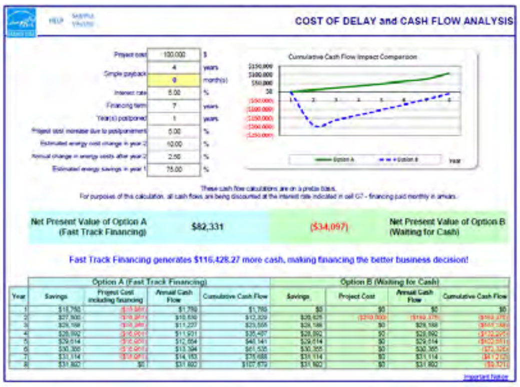
3.4.9.2 Cash Flow Opportunity Calculator

The Cash Flow Opportunity Calculator[42] helps in making strategic decisions about the financial aspects of energy efficiency projects. The tool enables users to estimate the amount of capital expenses that can be financed using anticipated savings, as well as timing issues – that is the impact of financing now versus waiting for a lower interest rate. All of these are highly relevant questions that CFOs will ask.

- How much new energy efficiency equipment can be purchased from the anticipated savings?
- Should this equipment purchase be financed now, or is it better to wait and use cash from a future budget?
- Is money being lost by waiting for a lower interest rate?

The CFO Calculator quantifies these costs and creates an understanding of the level of urgency about these projects. It addresses one of the most common responses from management - “we don’t have the money” . It helps energy managers to translate energy savings into “financial speak.” The basis of this tool (expressed in simple financial terms and logic) is the result of proven field experiences that have been used to sell energy efficiency projects to decision-makers in many real life cases.

[42] Cash Flow Opportunity (CFO) Calculator http://www.energystar.gov/buildings/sites/default/uploads/tools/A_Look_Inside_the_Cash_Flow_Opportunity_Calculator_FINAL.pdf



These calculations contain two somewhat counterintuitive financial conclusions:

(1) financing now is often better than waiting and paying no interest, and
(2) interest rates are rarely the most important consideration when evaluation financing options.

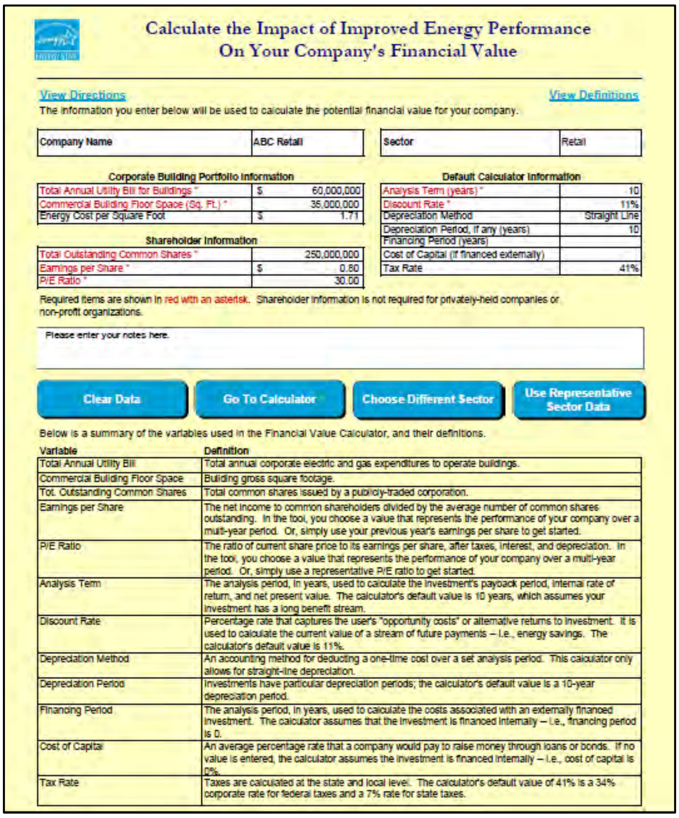
Properly explained, these conclusions can successfully change an organization's approach to energy efficiency projects, making immediate investments in energy savings a higher organizational priority.

Instructions to download the CFO calculator can be found at the following url :
http://www.energystar.gov/ia/business/cfo_calculator.xls

3.4.9.3 Financial Value Calculator

The ENERGY STAR Financial Value Calculator helps you quantify the value of improvements in energy efficiency to your organization. The calculator uses the prevailing price/earnings ratio to estimate the market value of increased earnings that can result from increased energy efficiency. The tool is also built on an Excel platform for ease of use. It presents energy investment opportunities using key financial metrics managers need to convey the message of improved energy performance to customers.

Instructions to download the Financial Value calculator can be found at the following url :
http://www.energystar.gov/ia/business/financial_value_calculator.xls



Calculate the Impact of Improved Energy Performance
On Your Company's Financial Value

View Directions | View Definitions

The information you enter below will be used to calculate the potential financial value for your company.

Company Name	ABC Retail	Sector	Retail

Corporate Building Portfolio Information

Total Annual Utility Bill for Buildings *	$	60,000,000
Commercial Building Floor Space (Sq. Ft.) *		35,000,000
Energy Cost per Square Foot	$	1.71

Shareholder Information

Total Outstanding Common Shares *		250,000,000
Earnings per Share *	$	0.80
P/E Ratio *		30.00

Default Calculator Information

Analysis Term (years) *	10
Discount Rate *	11%
Depreciation Method	Straight Line
Depreciation Period, if any (years)	10
Financing Period (years)	
Cost of Capital (if financed externally)	
Tax Rate	41%

Required items are shown in red with an asterisk. Shareholder information is not required for privately-held companies or non-profit organizations.

Please enter your notes here.

Clear Data | Go To Calculator | Choose Different Sector | Use Representative Sector Data

Below is a summary of the variables used in the Financial Value Calculator, and their definitions.

Variable	Definition
Total Annual Utility Bill	Total annual corporate electric and gas expenditures to operate buildings.
Commercial Building Floor Space	Building gross square footage.
Tot. Outstanding Common Shares	Total common shares issued by a publicly-traded corporation.
Earnings per Share	The net income to common shareholders divided by the average number of common shares outstanding. In the tool, you choose a value that represents the performance of your company over a multi-year period. Or, simply use your previous year's earnings per share to get started.
P/E Ratio	The ratio of current share price to its earnings per share, after taxes, interest, and depreciation. In the tool, you choose a value that represents the performance of your company over a multi-year period. Or, simply use a representative P/E ratio to get started.
Analysis Term	The analysis period, in years, used to calculate the investment's payback period, internal rate of return, and net present value. The calculator's default value is 10 years, which assumes your investment has a long benefit stream.
Discount Rate	Percentage rate that captures the user's "opportunity costs" or alternative returns to investment. It is used to calculate the current value of a stream of future payments – i.e., energy savings. The calculator's default value is 11%.
Depreciation Method	An accounting method for deducting a one-time cost over a set analysis period. This calculator only allows for straight-line depreciation.
Depreciation Period	Investments have particular depreciation periods; the calculator's default value is a 10-year depreciation period.
Financing Period	The analysis period, in years, used to calculate the costs associated with an externally financed investment. The calculator assumes that the investment is financed internally – i.e., financing period is 0.
Cost of Capital	An average percentage rate that a company would pay to raise money through loans or bonds. If no value is entered, the calculator assumes the investment is financed internally – i.e., cost of capital is 0%.
Tax Rate	Taxes are calculated at the state and local level. The calculator's default value of 41% is a 34% corporate rate for federal taxes and a 7% rate for state taxes.

3.5 The Business Case

In this section of the toolkit, some handy tips, suggestions are provided related to typical pitfalls, common objections, questions that should be internalized prior to presenting the business case and finally some ideas on building proposal.

3.5.1 Planning the Business Case Checklist

CheckList Item	Detail
When does the proposal need to be completed?	You may need to complete your business case proposal to meet a budget deadline, to meet compliance requirements under mandatory government programs or to meet a deadline for external funding.
What is the source of funding are you proposing to use?	Establish your primary source of funding as this will influence the level of detail required in your business case proposal.
Who will make the final decision on the project?	Sometimes this is not clear. By taking the time to identify the decision-makers early in the process you can more effectively target your proposal.
Will your proposal be written and/or require a presentation?	This will influence the structure of your final business case proposal.
Are there established guidelines that you will need to follow?	In some organisations and for external funding there are established protocols and templates that must be completed. Find out what these are early in the process to save time later.
What level of accuracy is required for your financial costings?	The level of accuracy will have a strong influence on the time and resources required to complete your proposal.
Are there people with experience and expertise that you can call on to help you develop your business case proposal?	By getting the involvement and advice from others you can save time and effort as you develop your business case proposal.
How much time do you have and what resources are available to help you develop your business case proposal?	The time and resources required to develop a proposal can vary depending upon the type of project. If you have not been allocated sufficient time and resources then you may need to let your manager know as soon as you are aware of this in order to discuss the options available to you.
Who needs to be consulted and involved in developing the business case proposal?	You will need to know this early so that you arrange to have the right people involved in the proposal process.
How and when might decision-makers be consulted?	This is an important part of building support for your proposal. Engaging decision-makers should happen well before a business case proposal is presented.
Is there a similar business case proposal that you can review and learn from?	This can save you time and effort.

3.5.2 Developing the Business Case Checklist

CheckList Item	Detail
What are the current business priorities in your organisation and how does your project link with them?	Linking to current business priorities can make a big difference to the level of support provided by management.
What are the risks associated with your projects and how can those risks be managed?	It is important to demonstrate to the decision-maker that you have identified and are managing implementation risks to give them confidence that implementation of the project won't lead to unintended consequences.
What are the direct and indirect 'whole of business' costs and benefits?	Include all of the "whole of business" costs and benefits to provide a more complete perspective on the project. Describe as clearly as you can those benefits that you cannot quantify.
Will your proposal be written and/or require a presentation?	This will influence the structure of your final business case proposal.
Are there established guidelines that you will need to follow?	In some organisations and for external funding there are established protocols and templates that must be completed. Find out what these are early in the process to save time later.
Are there additional funding sources that you have not yet considered?	Think outside the square and you may find alternative ways of financing your project.
Have you included all the information required and in a suitable format for your business case proposal?	An incomplete proposal could undermine your efforts to demonstrate to the decision-maker that you have a robust business case!

3.5.3 Writing the Business Case Checklist

This table provides a quick checklist for the business case, to ensure some major essential item is not missing prior to presentation to the executive management.

Item	Detail
Clearly state your value proposition upfront	At the beginning of your proposal it is important to briefly and clearly state why your project is important and the main benefits. This is where you can show a link to existing business priorities e.g. the potential for the project to achieve an important strategic goal.
Description of the project including any technical changes required and relevant planning issues	Make it clear. Language will need to be adapted to ensure the decision maker understands the proposal. This is particularly important when the decision makers don't have a technical background.
List all quantifiable costs and benefitse.g. amount of energy saved (GJ/$), CO2 emissions avoided, Wider project costs and benefits	Quantify as many of the costs and benefits as you can so that your business case proposal is complete.
List all non-quantifiable costs and benefits e.g. safety and reputational benefits	Even where you cannot fully quantify costs and benefits you should describe them. Do not assume that the decision makers will know about additional benefits even if they are obvious to you.

Item	Detail
Cost / benefit analysis to implement the opportunity	You may use simple payback, NPV, IRR etc. Whichever is required.
Analysis of project risks (e.g. financial, operational)	Describe the project risks and how you will manage them
How results will be monitored	This can give the decision maker confidence that you will follow through on your project and demonstrate the benefits if achieved.
Briefly describe the way you have developed your business case proposal and the people who helped you prepare the proposal	This can give the decision maker confidence that people with appropriate expertise and experience have contributed.
Describe the funding/ support you are seeking	Ensure that you are clear on the type of funding you require.

3.5.4 Common Business Drivers for Energy Efficiency

The following table outlines potential business drivers for energy efficiency which could be used in a Business Plan to make the case stringer. These are not designed to replace or be used with a weak financial case. The financial aspects need to be addressed separately, however these may provide sufficient additional incentive (tip the scales) to approve an energy efficiency plan or program.

3.5.4.1 Business Drivers Related to Cost and Productivity

Business Driver	Reason	Potential Indicator
Energy Savings	Direct energy savings are the obvious benefit of energy efficiency improvement, but there are many others.	Total energy reductions (Joules)
Cost reduction	These may include: · improved plant utilisation; · reduced water use; · reduced potential permit costs; · reduced waste charges; · reduced material inputs or handling costs	Energy intensity measures linked to output (e.g. energy used per full time employee, per 1000 km travelled, per ton of material moved, per ton of product manufactured) LEED or similar energy rating (buildings)
Avoided or deferred capital expenditure	Energy efficiency can reduce capital expenditure on plant by improving the efficiency of existing equipment or by reducing capacity requirements.	Value of capital avoided
Productivity improvement	Often energy waste is a sign of other problems, so energy efficiency improvements can reduce maintenance costs, increase plant output, or improve product quality. It can also improve	Increased production volume % improvement in production throughput

Business Driver	Reason	Potential Indicator
	working conditions and productivity of staff, for example by reducing heat from processes, improving daylight or reducing noise.	Comfort levels for tenants in commercial buildings (reduced complaints or positive feedback via survey) Reduction in the frequency of production downtime
Improved product/service quality	Energy efficiency improvements can also lead to improved product or service quality through improved consistency in production processes or better delivery of services to customers.	Comfort levels for tenants in commercial buildings (reduced complaints or positive feedback via survey) Production changes that improve consistency of production process by improving delivery of energy services such as compressed air, steam etc.
Energy contracts and pricing	Energy efficiency can significantly reduce energy costs if reduced demand can capitalize on incentives built into energy contracts and the way that energy is billed. For example, contracts may include incentives for reducing energy use during periods of peak demand.	Comparison of costs based on one contract arrangement versus another
Occupational health and safety	Looking at the way that energy is used can highlight occupational health and safety risks in the workplace related to issues such as temperature and steam.	Lost time injury frequency rate Hazards identified per employee
Employee involvement and motivation	Involving staff in programs to identify energy efficiency opportunities can make them feel more involved in decision making and contribute to improved levels of job satisfaction.	Job satisfaction surveys Feedback during performance management reviews
Improved profit margin	Profits are usually a small proportion of total turnover or input costs, so the cost reductions from energy efficiency may look small relative to turnover. Since they are often a significant proportion of profit margin however, the results can be visible to shareholders.	Total energy use and energy cost relative to variable operating costs and profit;
Achievement of greenhouse gas reduction objectives	Where energy efficiency improvements avoid use of fossil fuels or electricity generated from fossil fuels, they may contribute directly to an organisation's emission reduction performance. Understand fossil fuel related carbon liabilities and cost effective options to	Total greenhouse gas emissions reduced (CO2-e) Greenhouse intensity measures linked to output (e.g. C02 per full time employee, per 1000 km travelled, per tonne of material moved, per tonne of product

Business Driver	Reason	Potential Indicator
	reduce carbon costs.	manufactured)

3.5.4.2 Overall Business Drivers

Business Driver	Importance / Value
Energy supply issues	Security of supply is essential for business continuity
Rising energy prices	Rising energy prices will have an impact on overhead costs and profitability
Customer expectations regarding energy and greenhouse performance	Customer expectations may be product and service related (e.g. LEED rating of buildings or capability to deliver energy efficiency improvement through a contract). These may be reputation based (e.g. customers wanting to work with organizations that can demonstrate a commitment to energy efficiency and greenhouse gas reduction)
Employee expectations	The ability to demonstrate proactive action on energy efficiency and greenhouse gas reduction can attract and retain employees
Investor expectations regarding energy and greenhouse performance	Investors are looking at how well companies are managing energy and carbon risks, e.g. through reports to the Carbon Disclosure Project or the Dow Jones Sustainability Index
Local community concerns	Community awareness is growing regarding the actions that organizations can take to reduce greenhouse gas emissions through energy efficiency.
Legislative requirements	Companies have a range of legislative obligations, e.g. EEO, NGERS, EREP, NABERS mandatory disclosure in commercial buildings.
Government funding and tax benefits	The availability of government funding may improve the investment return for energy efficiency projects.
Maintenance, reliability and/or other operational issues	Implementing energy efficiency can deliver a range of co-benefits (see "whole of business benefits" checklist)

3.5.5 Typical pitfalls

- Using unexplained jargon or ambiguous terms
- Failing to address any issues of relevance to the management team
- Failing to consider other options for comparison
- Failing to identify and deal with risk factors
- Not using the appropriate financial appraisal method
- Giving a rambling presentation
- Not being crisp in the "ask" – what is being requested
- Not giving a single clear recommendation

3.5.6 Typical Objections

Before presenting the proposal, be prepared to answer these questions / objections / comments :

3.5.6.1 We are not convinced because…

- …the problem is not clear
- …we don't understand the solution
- …there is no evidence it would work
- …we disagree with the assumptions
- …the risks are too great
- …this is not the company's core competence

3.5.6.2 We like the project, but…

- …installing it sounds like it would be disruptive
- …we are not sure how long we are going to retain this building/process/equipment
- …the workforce would not accept it
- …we do not have any money available to fund the project
- …the necessary staff resources are needed for other work
- …one of us has got a better idea
- …why hasn't this topic or issue been addressed before?
- …who has done this project in the past and succeeded ?

3.5.7 Questions to be internalized

- Who in the management team is already onboard ? – Can they be a champion ?
- Who is not on board but needs to be influenced and convinced
- What are the management team interested in?
- What are their motivations?
- What is the best way to present information to them?
- Can their interest be garnered ahead of time?

3.5.8 How to build your case

- Know the residual life of affected assets
- Estimate the project cost and life
- Evaluate the requirements of other projects
- Calculate the cost, energy and carbon savings
- Identify sources of funding
- Work out a project timetable
- Calculate the internal rate of return and the net present value
- Carry out risk analyses
- Consult other interested parties
- Find any available precedents, case studies or technology references
- Identify any non-financial benefits

3.6 Energy Audits & Baseline

3.6.1 Levels of Energy Audits[43]

ASHRAE[2] defines three levels of audits – (1) Preliminary, (2) Survey & Analysis and (3) Detailed. Each audit level builds on the previous level with increasing complexity, thoroughness of the site assessment, the amount and accuracy of data collected, normally resulting in improved energy savings.

Level I: Site Assessment or Preliminary Audits include an assessment of energy bills and a brief site inspection of your building. It provides an overview of no-cost and low-cost energy saving opportunities and a general view of potential capital improvements.

Level II: Energy Survey and Engineering Analysis Audits an in-depth analysis of building characteristics, energy usage and energy with a more refined survey of energy usage patterns in the building in addition to Level I activities. It provides a no-cost and low-cost opportunities, and also provide EEM recommendations in line with preliminary financial analysis and potential capital-intensive energy savings opportunities.

Level III: Detailed Analysis of Capital-Intensive Modification Audits include monitoring, data collection and engineering analysis in addition to Level I and II activities. They provide solid recommendations and detailed financial analysis for major capital investments – in concert with the energy and financial teams in the organization. They are sometimes referred to as an "investment grade" audit.

Level I Audit Report	Level II Audit Report	Level III Audit Report
• **Executive Summary** • **Brief facilities description** • **Scope of audit/Methodology** • **Preliminary Analysis Findings, including benchmark and end use results** • **List of no-cost and low-cost energy measures** • **Potential measures for further consideration**	• All items from Level I Audit • More comprehensive energy end use analysis • Description of building systems and major equipment • Financial analysis of EEMs • Description of energy efficiency measures considered and not recommended or not financially viable • Description of energy efficiency measures recommended • Summary table with measure name, installed cost, energy savings by utility, and O&M savings • Capital Intensive measures requiring Level III audit • Detailed energy analysis calculations • Measurement and verification (M&V) plan for verifying energy savings	• All items from Level II Audit • Detailed information on capital intensive measures – including schematics, equipment specifications, design sequences and costs • Highly detailed financial evaluation

[43] http://www.pnnl.gov/main/publications/external/technical_reports/pnnl-20956.pdf

3.6.2 Common Issues to consider during an Energy Audits

Often, mistakes committed during an energy audit which causes the results to be inaccurate[44]. Consequently, these errors can be made into a checklist of items that one should expect in an audit.

Accurate Building Description : Ensure that there is sufficient description of the different building characteristics including Floor Area, Functions, Facades, Major Energy Systems, Orientation , Occupancy, Schedules, age of equipment, date of last retrofit, for example.

Missed Improvements : To ensure that common improvements are not missed, check if the following suggestions are included at a minimum :

- High Efficiency HVAC
- Improved HVAC controls
- High Efficiency Lighting
- Lighting Power Density
- Lighting Controls
- Wall / Roof Insulation
- Motors / Drives
- Façade / fenestration Improvements

Improvement Scope : Ensure that the energy auditor specifies the scope of the improvement to the building owner/energy team or contractor (who will implement the recommendations) in a clear and unambiguous manner. If this is not there or missing, there is a greater chance of an incomplete or incorrect energy conservation measure (ECM) will get implemented.

Payback Time : It is important that the expected lifetime of an improvements should exceed its payback time.

Life-Cycle Costing : This is an important aspect of an Energy Audit. This is being increasingly accepted as a more holistic metric for energy improvements than simple payback. Simple payback may not have the ability to distinguish the merits between 2 ECMs which may both have a similar payback times but radically different expected lifetimes.

Estimation of Installation Costs : Sometimes there is an incorrect assumption made for the time and cost of installation of an ECM. This can have an impact on overall budget as well as payback calculations.

Billing Analysis : Most well run audits will use different billing approaches for analysis including (1) monthly summaries of fuel bills (at least one year); (2) a true-up of bills to the energy audit model; (3) projected savings being a reasonable fraction of total annual use; and (4) some form of benchmarking (even if simple).

Overestimated Savings : Overestimated savings often arise from poor modeling, incorrect measurements or assumptions, or not accounting for interactive effects between improvements.

[44] 10 Common Problems in Energy Audits, Ian Shapiro, ASHRAE Journal, February 2011.

3.6.3 Advantages of an Energy Baseline

There are many advantages to establishing an energy baseline. Some of the more common ones include :

- Quantitatively evaluate an array of potential EEMs
- Quantitatively evaluate the interactions of multiple EEMs
- Measure performance of EEMs that have been implemented
- Greenhouse gas and energy reporting due to voluntary, mandatory requirements or recognition programs.
- Helps to establish how energy expenditures contribute to operating costs.
- Buildings which are performing well can be identified for recognition and replicable practices.
- Poor-performing facilities can be prioritized for immediate improvement.
- Historical energy use trends can be used as a context for future actions and decisions.
- Different types of energy analysis - fuel type, department, end-use etc can be performed and a visual dashboard created.
- Retro-commissioning activities and rewarding good performance can be started using the baseline.
- Sub-metering and circuit-level metering can provide detailed data about specific sub-systems and a more granular understanding of where and how energy is consumed.

3.6.4 Triple Bottom Line Benefits of Baselines

The “triple” bottom line of Economic, Environmental and Social benefits is quite apparent with energy baselining.

- Economic :
  - Reducing costs is possible when there is a fundamental understanding on the impact of energy expenditures contribute to operating costs. Literature has shown that energy savings of up to 20 to 30 % has been achieved compared to baseline, as a result of such an exercise.
- Environmental :
  - Baseline data can be used to determine the impact of the buildings’ energy use in terms of greenhouse gas emissions. Such data can be documented in a database to track annual improvements and therefore improvement to the environment.
- Social :
  - It has been shown that data, information, goals, and targets are provided, employees and communities often engage more proactively to reduce energy consumption.

3.7 Common EEMs

3.7.1 Common Lighting EEMs

3.7.1.1 Qualitative Assessment

Common EEMs for Lighting are listed in the table below with a qualitative estimate on the Complexity-Cost equation. The value will really depend upon the initial / original state of the building and therefore needs to be considered on a case by case basis and is therefore not discussed in the tables below.

Energy Efficiency Measure	Complexity	Cost
Replace Incandescents, T-12 Lamps and Magnetic Ballasts with T-5 or T-8 Lamps and Electronic Ballasts	Low	$
Replace Standard T-5 or T-8 Lamps with Low Wattage T-5 or T-8 Lamps and Low Ballast-Factor Ballasts	Low	$
Install Perimeter Dimming Ballasts	Low	$
Install Low Wattage Screw-In Lamps	Low	$
Optimized Interior Security Lighting	Low	$
Replace Exit Signs with LED Exit Signs	Low	$
Replace Incandescent Recessed Can Fixtures with LED or CFL Lighting	Low	$
Replace Incandescent and Fluorescent Cooler/Freezer Lights with LED Lighting	Low	$
Replace/Install Under-Cabinet and Task Lighting	Low	$
Install Occupancy Sensors in Bathrooms, Conference Rooms, and Private Offices	Low	$
LED Lighting	Medium	$$
Install Central Lighting Management System	Medium- High	$$-$$$
Reduce Lighting Levels on Over-Lit Spaces	Low	$
Replace Linear Fluorescent “Milky White” Lens with Clear Acrylic Prismatic Lens	Low	$
Install Metallic Reflectors	Low	$
Conduct a comprehensive lighting retrofit of your office, which can save more than 25% on your lighting costs.	Low	$
Maximize natural lighting in your work space.	Low-Medium	$-$$
Clean light fixtures and windows.	Low	$
Place signs throughout office reminding employees to turn off lights when leaving a room.	Low	$

Energy Efficiency Measure	Complexity	Cost
LED Task Lighting	Low	$

3.7.1.2 Quantitative Analysis

The tables below list the estimated costs of enhanced Lighting technologies[45] including the cost of installation and associated benefits.

Enhanced Technology	Materials	Labor	Total
Lighting Ballasts			
HID hi-lo	$50-$100	$100-$150	$150-$250
Fluorescent dimming ballasts	$50-$75	$10-$200	$85-$275
Lighting Sensors			
Wall mount occupancy sensor	$50	$10	$60
Ceiling mount occupancy sensor	$100	$50	$150
Daylight photo sensor (per system)	$50	$60	$110
Lighting Controls			
Dimmer, two fixtures per circuit (per fixture)	$440	$270	$710
Dimmer, ten fixtures per circuit (per fixture)	$175	$110	$285
Timeclock, 24 hour electromechanical	$40	$90	$130
Timeclock, 7 day digital	$30	$70	$100
Timeclock, 7 day electromechanical	$110	$90	$200
Timeclock, 7 day electromechanical, 3 phase*	$300	$90	$390
Central (EMS) control (per point)**	n/a	n/a	$1,100

3.7.1.3 Estimated Savings from Lighting Enhancements

Current	New (Upgrade)	Estimated Costs of enhancements	kWh savings*
Manual On/Off whole circuits	Bi-level lighting, sweeping off one or two lamps of a fixture or checkerboard fixtures	$1,000 per circuit	5%-15%
Manual On/Off (shut off by staff in evening)	Sweep control via EMS (lights are "swept" off periodically unless local override is requested)	$500 to $1,000 per circuit	5%-10%

[45] Technical Options Guidebook, California Energy Commission http://www.energy.ca.gov/enhancedautomation/documents/400-02-005F_TECH_OPTIONS.PDF

Current	New (Upgrade)	Estimated Costs of enhancements	kWh savings*
No light level control (fluorescent)	Dimming controls (via EMS)	$50 to $100 per ballast plus $500 to $1,100 per lighting circuit for EMS dimming control	2%-10%
No light level control (HID fixtures)	Multi-level on/off control (multi-level ballast)	$250-$750 per fixture plus $500 to $1,100 per fixture control via EMS	2%-10%
Constant, variable or multiple light level control (via EMS)	Demand or price- responsive control (via EIS)	$1,100 per lighting control point	2%-10%

3.7.2 Common HVAC EEMs

3.7.2.1 Qualitative Assessment

Common HVAC EEMs are listed in the table below with a qualitative estimate on the Value-Complexity-Cost equation. The value will really depend upon the initial / original state of the building and therefore needs to be considered on a case by case basis and is therefore not discussed in the tables below.

General Heating, Ventilating, and Air Conditioning Checklist

Energy Efficiency Measure	Complexity	Cost
Deploy Scheduled Operation and Maintenance Programs	Low-Medium	$-$$
Install Programmable Thermostats	Low	$
Consider Using a Solar Ventilation Preheating System for Combustion Air	High	$
Replace Pneumatic Sensors with Electronic Sensors	High	$$
Install Dedicated Outside Air AHUs	High	$$
Exhaust Air Energy Recovery	High	$
Variable Refrigerant Flow System	Medium	$ - $$
Sensible and Latent Energy Recovery Ventilators	High	$ - $$
Heat Recovery Chillers	High	$
Liquid Desiccants with Solar Thermal Energy	High	$$
Radiant Cooling Systems or Chilled Beam Systems	High	$$

Chilled Water System Checklist

Energy Efficiency Measure	Complexity	Cost
Convert Three-Way Chilled Water Valves to Two-Way Valves	Medium	$$
Install More Energy Efficient Chillers (example VSD)	High	$
Replace Large Air Cooled Cooling Equipment with Water Cooled Chillers and Cooling Towers	High	$
Reset Chilled Water Supply Temperature Based on Cooling Coil Valve Position	Low	$$
Reset Condenser Water Based on Outside Air Wet-Bulb and Install VFDs on Cooling Tower Fans	Medium- High	$$
Convert the Primary/Secondary Chilled Water Plant to Variable Flow Primary	High	$
Install a Desiccant Dehumidification System	High	$ - $$

Air Handling Checklist

Energy Efficiency Measure	Complexity	Cost
Verify Proper Operation of Air Dampers	Low	$$
Verify Proper Operation of Air-Side Economizer	Low	$
Verify Proper Operation of Heating and Cooling Valves	Low	$
Check the Condition of Heating and Cooling Coils and AHU Filters	Low	$$
Eliminate Duct Leakage	Medium	$$
Eliminate 100% of Outside Air Systems if Practicable	High	$
Reduce Outside Airflow Rates to ASHRAE 62.1-2010	Medium	$ - $$
Implement an HVAC System Night Setback Schedule	Low	$ - $$
Track HVAC Setback	Low	$
Monitor Exhaust Fan Controls	Low	$$
Slow Down Systems During Unoccupied Hours	Low	$$
Adjust Total Airflow and Head if a Constant Air Volume System	Medium	$$
Convert the Constant Volume System to a VAV System	Medium-High	$$
Implement a Supply Air Temperature Reset Schedule if a Constant Air Volume System	Medium	$

Investigate Duct Static Pressure in a Variable Air Volume System	Medium	$
Reset the Supply Air Temperature in a Variable Air Volume System	Medium	$

3.7.2.2 Quantitative Analysis

The tables below list the estimated costs of enhanced HVAC technologies[46] including the cost of installation and associated benefits.

Measure	Costs	Notes
Shut-off with high limit	Programming time	
Night ventilation	Programming time	Activate HVAC fans in economizer mode
Optimal start	$100-$1,100 per zone	If additional hardware (e.g., temperature points) is needed, cost will be on the high end of the range – otherwise only programming time
Variable capacity control	$300-$500 per horsepower plus programming time	Adding a VSD can change the design of the HVAC system
Demand-responsive ventilation	$1,000-$4,000 per system, CO_2 or CO sensor costs $100-$300 each	Several additional sensor points, wiring, and programming
Thermal storage	$200-$400 per ton-hour or $500-$800 per ton-hour if new chiller is needed	Costs are for storage tanks, pumps, heat exchangers, and piping – new chiller might be required for efficient operation at low temperatures
Shut-off with high limit	20%-40%	Compared to full time operation at occupied temperature setpoints and for typical 9-to-5 building
Night ventilation	0.1%-2% of cooling energy use	May reduce morning demand on the HVAC system
Optimal start	5%-10% of fan and heating/cooling costs	Saves hundreds of hours of fan and cooling system operation compared to fixed start- time

[46] Technical Options Guidebook, California Energy Commission http://www.energy.ca.gov/enhancedautomation/documents/400-02-005F_TECH_OPTIONS.PDF

Measure	Costs	Notes
		strategy
Variable capacity control	10%-30% of fan or pump energy use, 5%-15% of total building energy use	Benefits are highly site and application specific, peak demand savings tend to be lower because variable-capacity systems have more impact on efficiency during part-load operation
Demand-responsive ventilation	20%-70% of ventilation HVAC use, 2%-7% of total building energy use	Compared to outside air flow rates in normal operation
Thermal storage	10%-50% of cooling use, 2%-10% of total building energy use	Compared to conventional, non-storage operation

3.7.3 Building Envelope based EEMs

The following is a list of other common potential EEMs related to Building Envelope classified by Cost and Complexity. The value will really depend upon the initial / original state of the building and therefore needs to be considered on a case by case basis and is therefore not discussed in the tables below.

Energy Efficiency Measure	Complexity	Cost
Replace Old or Single-Pane Windows to Low-E Insulating Glass	Low	$$
Add Film to Old or Single-Pane Windows	Low	$
Install Additional Insulation in Exterior Walls	Medium	$$
Seal Areas of Infiltration in Exterior Walls	Low	$
Fix Rain Leaks in Exterior Walls	Low	$
Install Solar Shading on E-W-S Facing Facades	Medium	$$
Install Revolving Doors	Low - Medium	$$
Create Entrance Vestibule with Two Doors	Low - Medium	$$
Install Weather-Stripping On Loading Dock Doors	Low	$
Increase Roof Insulation	Medium	$$
Retrofit Existing Roof with Green Roof or Cool Roof	Medium	$$$

3.7.4 HVAC Control and Energy Management based EEMs

3.7.4.1 Benefits of an EMS Installation

The energy savings benefits from installing an EMS system compared to older BAS systems can range between 10 to 15 % and the additional monitoring points and sensors can provide increased energy savings beyond that. Other benefits include improved system operation, energy management and control, and management of system maintenance

Benefit	Specific Details
Improved system operation	• Higher sensor accuracy • Superior temperature control and occupant comfort • Centralized scheduling • Higher control scheme complexity capability
Improved energy management and control	• Efficient equipment operation • Energy use tracking (used to monitor performance of energy saving operation strategies or sub-metering tenant spaces) • Central building system monitoring • Ability to implement control strategies
Improved management of system maintenance	• Central and remote building system monitoring • Recording of equipment runtime and automatic generation of scheduled maintenance work orders • Trending and monitoring of system parameters used for troubleshooting building systems and equipment • Alarm monitoring to detect abnormal conditions and equipment malfunctions and notification • Improved response time to abnormal system operation • Automation of daylight savings time adjustments
Additional benefits	• Connection to multiple facilities and software tools provides easy aggregation of energy real time use, allowing enterprise level analysis and decision making • Integration of multiple building systems (building access/security, fire), resulting in intelligent buildings • Sub-metering of utilities for tenant billing or tracking of energy project performance

3.7.4.2 Estimating Costs

However, such systems are complex and typically quite expensive. While the costs of the hardware is continuously decreasing with the advent of cheaper sensors and control devices, installation costs remain high since it is a highly valued skill to install such systems.

There are two sets of costs to consider :

1. Raw Cost of the actual sensors and control devices and associated labor for installation.

2. Overall system level installation costs including the additional system level costs – hardware, software (beyond the actual sensors and control devices), outside air temperature measurements, control panels, the data communication network, calibration, system commissioning and project management.

A good rule of thumb maybe $ 1200 per point installed (50 % for the sensors and installation and 50 % for the overall system). Caution needs to be exercised when using such rules of thumb, since point costs can vary widely, depending on the type and cost of the end device, distance from control panel, need for new conduit and wiring, level of installation difficulty and complexity of system as a whole.

Raw Cost Estimate

The table below provides an estimate[47] for typical raw costs for common end devices for energy management systems. The cost for labor far exceeds the cost of devices since these sensors and devices are quite complex. The average cost can be estimated at $ 600 per point.

	End Device	Cost of Device	Labor	Total Cost
Monitoring Points				
Outside Air Temperature	RTD with Outside Air Enclosure (C)	$ 40	$ 600	$ 640
Space Temperature	Wall mount RTD (P)	$ 30	$ 600	$ 630
Exhaust Air Temperature	Duct Mount RTD Temperature Sensor (C)	$ 65	$ 325	$ 390
Chilled Water Temperature	RTD Temperature Sensor and Brass Well– new Construction (C)**	$ 90	$ 850	$ 940
Duct Static Pressure	Differential Pressure Sensor (C)	$ 275	$ 325	$ 600
Fan Status	Current Sensor (C)	$ 100	$ 480	$ 580
Electric Consumption	Electric Meter (C)	$ 1,150	$ 500	$ 1,650
Water Consumption	4 inch Water Meter – new construction (C)	$ 1,650	$ 650	$ 2,300
CO_2 Level	Duct mount CO_2 sensor (C)	$ 800	$ 425	$1,225
Control Points				
Chilled Water Valve Control **	3 inch 2-Way Valve with Electric Actuator– new construction (C)	$ 530	$ 550	$ 1,080
Mixed Air Damper Control **	(2) Electric Damper Actuators,Proportional w/Spring Return (C)	$ 960	$ 500	$ 1,460
Fan Speed	VFD input (C)	$ 125	$ 325	$ 450

[47] Technical Options Guidebook, California Energy Commission http://www.energy.ca.gov/enhancedautomation/documents/400-02-005F_TECH_OPTIONS.PDF

	End Device	Cost of Device	Labor	Total Cost
Pump Start/Stop	Low Voltage Relay (C)	$ 35	$ 595	$ 630

System Level Costs for a system with 250 points

The table below provides an estimate[48] for typical system level costs for approximately 250 points. The average cost can be estimated at $ 600 per point.

	Description	Unit Material	Unit Labor	Total (250 points)
Hardware & Software System Components				
Outside Air Temperature	Includes processor, system software, Computer + Printer + Other Accessories	$6,000	$ 250	$ 6,250
Central Computer Software	Provides remote monitoring and control and advance control strategies	$6,000	—	$6,000
BAS Communications Network	Plenum cable, 2000 ft	$ 1.50/ft	$ 2.00/ft	$ 7,000
(13) 16-Point Control Panel	Materials and installation	$2,000	$300	$29,900
(4) 32-Point Control Panel	Materials and installation	$3,500	$550	$16,200
Systems Design & Installation				
Calibration	Analog Point Calibration	—	$80/point	$ 20,000
System Commissioning	Includes end-to-end wiring check, end devices operation, program installation and verification	—	$120/point	$30,000
System Engineering	Includes system design and point programming	—	$80/point	$ 20,000

[48] Technical Options Guidebook, California Energy Commission
http://www.energy.ca.gov/enhancedautomation/documents/400-02-005F_TECH_OPTIONS.PDF

	Description	Unit Material	Unit Labor	Total (250 points)
Project Management	136 Hours	—	$ 120/hr	$ 16,320
TOTAL				151,650

Average Cost per point ~ $ 600.

3.7.5 Other Common EEMs in Office Buildings

Energy Efficiency Measure	Complexity	Cost
Centralized Computer Power Management	Low to Medium	$-$$
Use Laptops with Docking Stations instead of Desktops	Low	$
Use of ENERGY STAR certified Office Appliances & Equipment	Medium	$$
Mandate Use of Network Printers – Eliminate Personal Printers	Low	$
Distribute information about efficient computer, monitor, and electric machinery use to your employees.	Low	$
Manually reduce the brightness level of your office's computers.	Low	$

3.8 Reality Check

It is very important to note that all the different scenarios described in this toolkit may or may not apply to every situation. The specific implementation of an EEM needs to be carefully considered and applied to in a very contextual manner. A few specific examples are provided below:

3.8.1 Energy Data

There may not be access to primary energy data. Billing information may be available but bills do not necessarily provide the necessary detailed breakdown of energy usage. Current levels of metering and sub-metering and energy networks are not necessarily at a level of detail which may be desired. In order to make the changes needed, considerable funding may be needed (not always possible).

In such a situation, it is sometimes better to wait until EEMs are implemented and then device ways to meter / measure to see impact, rather than try to modify entire infrastructures up front.

3.8.2 Audits

In the real world, building assets are being managed, and therefore it is essential to define what is appropriate and should be done with respect to the buildings and what should not be done. Audits which cannot be avoided include 2 aspects - Energy and Structure.

The output or deliverables need to be seen as a multi-year action plan. Such an approach has some advantages :

- Provides the opportunity to have a holistic approach (as opposed to a segmented approach comparing EEMs one by one). One can therefore conceive a technical goal with a consistent set of measures.
- The EEMs can be planned and spread over time, considering the availability of necessary finances, remaining consistent in the overall goals.
- If the EEM can be coincided with some other physical building structural work, there may be economies of scale, thereby reducing costs and improving the ROI.

3.8.3 Time Horizons

Timelines for returns from EEMs are not always in synch with that of the needs or policies of a corporation. The timelines for a good RoI from an EEM may exceed the acceptable economic timeline. For example, most companies would like to see an RoI within 3 years or less and an EEM may take 5 years to become financially viable. In most cases, as has been emphasized in this toolkit, the economics of a situation is critical and so the economic timeline / horizon will prevail.

Under such a scenario, typical ROI calculations will need to be limited the economic timeline but every attempt should be made to see if there is some flexibility in this economic timeline (by say 1 or 2 years), since there maybe longer term benefits.

Another example is that if the facilities, asset and energy management of a company owned building is done by an external company, it may not be possible to EEMs included until coincident with the timeline for renewal for renegotiation of the contract.

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