ECO-III-1040

Energy Conservation and Commercialization (ECO-III)

Envisioning the Building Performance Initiative

Final Report

Saket Sarraf, Shilpi Anand Saboo, Shravani Gupta
ps Collective

September 2011

Submitted to
Aalok Deshmukh
Chief of Party (Team Leader), USAID ECO-III Project
International Resources Group

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Contents

Acknowledgements: Aalok Deshmukh, Bill Bordass, Satish Kumar

***ps* Collective Team:** Saket Sarraf, Shilpi Anand Saboo, Shravani Gupta

The document presents the road map for the Building Performance Initiative (BPI) that will host the National Building Star Rating Program and pioneer research on building energy performance-related issues in India. The BPI is envisaged as a consortium of government and regulatory bodies, academic institutions, industry representatives, and other multilateral and funding agencies working in the field of building energy efficiency. The purpose of this document is to create a platform towards building a consensus and to facilitate debate on institutional response and activities towards enhancing building energy efficiency in India.

LIST OF ACRONYMS

BEE	Bureau of Energy Efficiency
BPI	Building Performance Initiative
CDM	Clean Development Mechanism
ECBC	Energy Conservation Building Code
EEB	Energy Efficient Buildings
IIIT	International Institute of Information Technology (Hyderabad)
IIMA	Indian Institute of Management (Ahmedabad)
M & V	Measurement and verification
MNIT	Malaviya National Institute of Technology (Jaipur)
REEC	Regional Energy Efficiency Center
UNEP	United Nations Environment Programme
WBCSD	World Business Council for Sustainable Development

1 The Building Performance Initiative for India

1.1 Context

a. Buildings are responsible for 30-40 percent of total energy use worldwide (UNEP, 2007; World Business Council for Sustainable Development, 2007).
b. Approximately 80-90 percent of the energy a building uses during its entire life cycle is consumed for heating, cooling, lighting, and other appliances. The remaining 10-20 percent is consumed during the construction, material manufacturing, and demolition phases (UNEP, 2007).
c. The fourth assessment report of the Intergovernmental Panel on Climate Change (IPCC, 2007) states that the building sector has the largest potential for significantly reducing greenhouse gas emissions. And, that the greatest and cheapest potential for reducing energy demand in buildings was found to be in developing countries.
d. There exists a wide gap in performance levels as anticipated during the design stage to those achieved after construction and during regular operation of buildings; and designers are often isolated from operational realities. Further, the magnitude of this gap has not been a subject of intense scrutiny in practice or research.
e. There is a considerable lack of focus on issues of long-term performance among academicians, policy makers, various rating systems, and even the building managers. There is far too much emphasis on intended performance, procuring and installing equipment/products (e.g., lights and controls) rather than on ensuring delivery of the services required with efficient performance over time.
f. There is very little knowledge about the actual, verified performance of buildings. Building staff are often too busy troubleshooting day-to-day activities instead of concerning themselves with maintaining and recording performance levels.
g. The Energy Conservation Act of 2001 mandates the Energy Conservation Building Code (ECBC) to be linked with Energy Use Intensity expressed as kWh/m^2. However, it is silent about what its value should be for different buildings and also about a methodology to arrive at the same.
h. Finally, there is no designated champion for assurance of building performance in the buildings value chain.
i. There is an urgent need for governments to establish national policies that promote energy efficiency in the building sector, as a strategy for reducing national energy demand and GHG emissions and to adopt energy efficiency investments as part of its normal business practices. (UNEP SBCI, 2008)

1.2 Vision

To create a multi-disciplinary multi-stakeholder, knowledge-based consortium to advance energy efficiency in buildings in India for accelerated improvement in building energy performance by increasing demand side pull for energy efficiency and reducing the gap between design expectations and actual energy consumption in buildings. This consortium will create an entity called the Building Performance Institute (BPI), which will chart the path towards enhanced building energy performance in India by working collaboratively with businesses, government officials, public interest groups, and other organizations.

1.3 Aim

The BPI will focus on issues pertaining to improving building performance in the country. It will work on issues of energy efficiency, performance enhancement, monitoring, measurement and verification in buildings through:

a. Providing policy support and research
b. Working on industry-sponsored research
c. Conducting capacity building and training activities
d. Developing products and services

In addition, it will host the secretariat for the national building star rating program. The BPI will aim to:

a. Develop and use building performance benchmarking and labeling as a means to an end, leading to actionable feedback for operation, maintenance, retrofit, and design of new buildings
b. Create an emphasis on providing the end-use service (e.g., lighting) in the most efficient manner and not on the amount or type of goods (e.g., particular lamp technologies, controls, etc.) needed to provide it
c. Mandate disclosure of actual, verified building performance in real estate transactions (buy, sell, and lease) in terms of policy as well as market mechanisms, for high visibility of actual, verified building performance
d. Help facilitate an Energy Efficient Buildings (EEB) program and policy under the Clean Development Mechanism (CDM)
e. Develop the market for energy efficiency financing to the customers and suppliers

2 Short-Term Approach

Each of the above listed issues is significant in its own right. However, given the sheer complexity in terms of absence of a formal organizational structure, limited resources and lack of data, a more gradual approach, which can be adopted under a loosely cohesive structure, is suggested in this section. Activities listed in the previous section need a sound organizational structure and financial support, which is discussed in section 3 under the title "Long-Term Initiatives."

The energy performance of a building depends on its design, construction, and operation. Often, there is a difference between the intended performance based on design calculations and the constructed building. Further, the decline continues over its operational life. The variations in the construction and operational practices from the default assumptions further contribute to performance reductions over time. However, it has been found that most of the performance inefficiencies "arise from poor briefing, design, construction and commissioning and not just bad training, bad maintenance and bad management" (Bordass, Cohen and Field, 2004). Some of these differences can be attributed to imperfect predictive tools used in design assistance. However, it was found that most of the differences can be attributed to ill-informed assumptions used during the design stage because people who design the buildings rarely monitor their performance to assess the gaps in the design stage. The short-term initiatives have been drawn up to work on some of these issues, particularly focusing on:

a. Equipping designers with more informed assumptions in the design stage, where it is least expensive and most effective, to help reduce the performance gap. This will lead to improving the transparency and reducing the performance gap.
b. Creating usable benchmarks and performance labels as a means to reduce the gap between design intent and outcome, and to maintain and monitor performance over time to provide a feedback to those responsible for building operation

It is agreed upon that the activities of the center be started by focusing on just a few projects rather than setting out with a grand business plan at the outset. These quick wins will help establish the credibility of BPI and attract other stakeholders and funding over time, helping the center to grow in an organic manner. Some of the proposed short-term activities are:

a. Survey of assumptions commonly used by designers, such as:
    i. Operating schedules for occupancy, lighting, air-conditioning, etc.
    ii. Installed and utilized power densities for lights, equipment, etc., for different building types
b. Creating usable benchmarks and performance labels as a means to reduce energy consumption by:
    i. Moving to asset and operational ratings
    ii. Choosing appropriate performance indicators
    iii. Using a graduated approach model

3 Long-Term Initiatives

3.1 National Building Star Rating Program

The BPI will provide the technical backbone to the national building star rating program. It will:

a. Provide a roadmap for the star labeling program development and implementation
b. Host the secretariat for the national building star labeling program and provide technical support in its day-to-day activities
c. Continuously improve the technical methodology to address known shortcomings
d. Create an institutional mechanism to collect data at periodic intervals to be relevant to market transformations
e. Expand the coverage of the program to different building types and sub-types
f. Develop and update the model for benchmarking using newly gathered data
g. Inform the Bureau of Energy Efficiency (BEE) about the status of program from time to time
h. Publish annual reports on the state of the building performance in the country based on the data collected under the National Star Rating Program, including:

    i. Current status
    ii. Changes from past status
    iii. Future projections
    iv. Special reports on different building types
    v. Estimate of floor space
    vi. Trends in commercial building sector
    vii. Definition of a typical building in terms of its construction, operation, and energy consumption characteristics
    viii. Establish and document good, best, and exemplary performing building through analytical work, technical expertise, and case studies
    ix. Other reports

3.2 Research on Performance Enhancement, Monitoring, Measurement and Verification

The BPI will also carry out the necessary research required to build the body of knowledge in order to effectively achieve its vision, including activities such as:

a. Creation of baselines for assumptions used at the time of design, such as occupancy schedules, power densities, etc.
b. Creation of programs for system level action-oriented benchmarking
c. Connecting building controls to energy efficiency
d. Creation of an emerging technologies program for quicker adoption
e. Increasing the efficient and effective use of energy, energy efficiency tips for hotels, hospitals, and residencies and other building types
f. Creation of a seamless database using building property records, utility meters, satellite imagery, business statistics from industry associations, etc. to generate key statistics like built-up area, aspect ratio, number of floors, energy consumption, etc.
g. Create national baselines for different Measurement and Verification initiatives in the building energy sector at the whole building level as well as for different systems and components
h. Develop methodology for real time benchmarking and performance evaluation of energy consumption to support fault detection, time varying tariff strategies for DSM programs, and creation of proper incentive policies.

3.3 Policy and Program Support

a. Connect performance labels to ECBC, and other rating programs, such as GRIHA and LEED

b. Coordinate with the initiative on net zero buildings, provide technical support to estimating the overall benefits to owners and society and estimating the fiscal impact of non-cost barriers
c. Develop and implement best practices in energy design assistance, construction, maintenance, and management of buildings through the application of integrated approach, processes, and advanced technology
d. Coordinate and pool resources from various institutes, organization, government bodies, and industry for optimal usage of facilities and resources to meet research objectives
e. Advise policymakers and program managers

3.4 Industry-Sponsored Research

a. Promote industry-based research through collaborations and engagement at the local and international levels
b. Advice and analysis enabling facilities to increase the profit through the efficient use of energy resources.

3.5 Capacity Building, Training, and Dissemination

The consortium will assist the implementation agency in creating training materials and “Training of Trainers" programs for government officials, building professionals, financial institutions, and performance assessors. Further, the initiative can engage in demonstration and pilot projects towards program development, implementation, and information dissemination. Other activities can include:

a. Documentation of case studies and success stories, model energy design assistance projects, a catalogue of simulation input baselines for different building types, etc.
b. Provide training and consultancy services to the industry through the organization of continuing professional development programs, focused workshops, and interactive forums
c. Educate businesses and consumers through our reports, books, conference proceedings, media outreach, and website
d. Disseminate research findings and output through publications, seminars, workshops, and conferences, primarily for energy efficiency professionals
e. Assist and encourage the media to cover energy efficiency policy and technology issues

3.6 Products and Services

Some of the research, training materials, and other intellectual property generated by the BPI can be converted into products and services, some of which may be monetized to support the initiative. The BPI may also provide independent performance-related certificates for areas not covered under the national policy. The research activities can result in different libraries for material properties, simulation input parameters, widgets for data visualization and analysis, etc., which can be shared in the public domain.

4 Organization of the BPI

4.1 Organization Structure of the BPI

The BPI will create its charter with focus on improving building performance in the nation and create an organizational structure to facilitate its functioning. The structure of the initiative may take the form as shown in Figure 1.

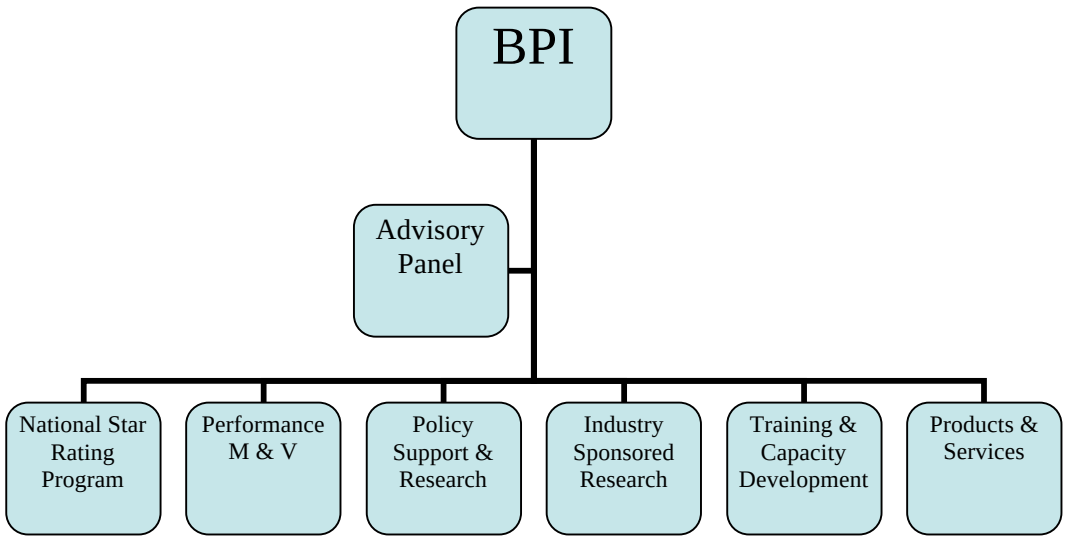

Figure 1: Proposed Structure of the BPI

The activities of the initiative will be governed by an advisory panel consisting of eminent researchers, industry representatives, and policy makers. The advisory panel will provide vision, guidance, and support to ensure that the activities of BPI reflect national priorities, are academically rigorous, and help in market transformation. Industry representatives from different building sectors (manufacturing, services, building sectors, etc.) will ensure that the market relevance of the research in the short and long term is maintained and that it helps to provide meaningful insights and direction to prepare them to meet the emerging demands.

The initiative will have an executive director responsible for translating the vision into projects and targets through coordination with the various technical arms. The director will also be responsible for securing funding from various sources and ensuring the sustainability of the program. The different technical arms will have their own technical leader, research team, and industry partners. These arms may be located in different parts of the country, depending on available resources and expertise.

4.2 Relation of Star Rating Cell at BEE with BPI

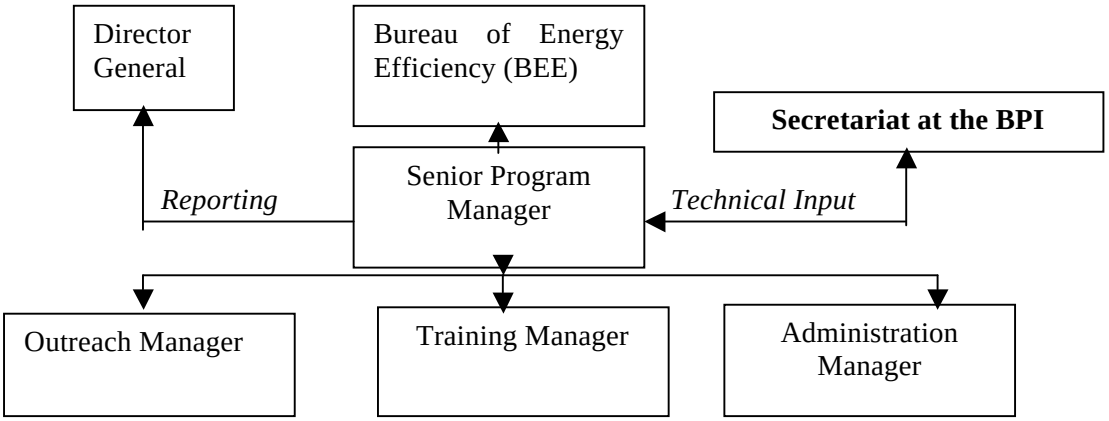

Figure 2: Proposed Structure of the Benchmarking Cell at BEE

Proposed structure for a separate program office for Star Labeling Program at BEE where a Senior Program Manager will directly report to Director General of BEE. Under the Senior Program Manager, there will be three managers taking care of three different functions, viz. Outreach, Training, and Program Administration. The staff could be existing employees of BEE or hired specifically for a particular task. The senior program manager will be the interface between BEE and the secretariat at the BPI.

4.3 Financing and Sustainability

Funding options and deliverables vary depending on the source. Donor organizations normally want to fund projects that have periodic deliverables, have immediate relevance, and can demonstrate near-term impact. Government agencies on the other hand can provide long-term funding on issues that have long-term significance. Industry can provide support to more of the product, services, and technology-driven initiatives. The initiative may be able to get some funding from Bureau of Energy Efficiency to support the National Building Star Rating Program. The steering committee will identify other funding sources concurrently. Some sources of funding may include:

a. Product manufacturers and service providers (e.g., Schneider Electric India, Tata Group, etc.)
b. Industry associations (e.g. hospital / hotel industry associations)
c. Multilateral / Bilateral Programs (e.g., agencies like USAID, USDOE, GIZ, UNDP)
d. Donor organizations such as Infosys Foundation and ClimateWorks Foundation
e. Grants from state and central government
f. Money from patents, training, products, and services

The BPI can run the benchmarking program with the help of industry participation. Once it has reached a level of maturity and self-sustenance, it may be transferred to the government.

4.4 Intellectual Property Rights

The intellectual property rights of the work undertaken under the BPI can be shared under a creative commons agreement or similar alternate arrangements. This is a very important issue and would need substantive discussions to avoid discouraging the active participation from the consortium members, including the research institutes and industry.

4.5 Seat of the Initiative

a. The initiative, though national in its scope, has to have a physical address. It should be located within an organization that has well established credibility, has domain expertise, and is networked with various national and international organizations. Given these criteria, CEPT University is an ideal candidate to host the initiative, given their exemplary contribution in the field of built environment and leadership in sustainable design through the Center for Sustainability and Energy Efficiency. It offers the following advantages:
b. Is a premier institute in India presently engaged in education, research, and planning and development of the built environment
c. Currently hosts the Regional Energy Efficiency Center (REEC) for Buildings, developed under the USAID funded bilateral ECO-III project
d. Is capable of undertaking first-rate collaborative research projects
e. Has academic setting and neutral perspective, brings higher credibility
f. Has the potential to increase the staffing strength to desired levels
g. Receives research grants and financial support and technical assistance from Ministry of New and Renewable Energy, Government of Gujarat, Bureau of Energy Efficiency, Ministry of Environment and Forest, etc.
h. Has established partnerships in place with other leading institutions, such as the International Institute of Information Technology (IIIT), Hyderabad; Malaviya National Institute of Technology (MNIT), Jaipur; and the Indian Institute of Management, Ahmedabad (IIMA)
i. Has the advantage of and enjoys the confidence of a good network of international partners

5 Partners and Stakeholders

The building performance initiative is conceived as a consortium of various stakeholders – government, academic, and industry as well as various multilateral and bilateral agencies, funding organizations, etc. This section lists various potential partners, including the benefits they will bring to the consortium, the value proposition for them to be willing partners, and their roles and responsibilities. A list of partners who have already shown some level of interest over the last few years in improving building energy performance is also indicated.

5.1 Government and Regulatory Partners

The government and regulatory partners will bring credibility to the consortium and its work, create a public goods target for its initiatives, provide access to data across different departments, help in participating in policy deliberations, help obtain long-term funding, and strive for transparency in its functioning. In return, the work done by the consortium will provide robust technical support, stakeholders buy-in, and transparency in developing policies and programs at the national and state level. Some suggested partners in this category include:

a. Bureau of Energy Efficiency, Ministry of Power
b. Ministry of New and Renewable Energy
c. Ministry of Statistics and Program Implementation
d. Ministry of Urban Development and Housing
e. IREDA

5.2 Academic Partners

Academic partners will provide technical strength, value neutrality, and academic rigor to various activities performed by the consortium. The participating academic institutions would be recognized leaders in the field of building energy efficiency and associated disciplines and will have access to supporting funds for carrying out the research. Some suggested partners include the CEPT University, IIIT Hyderabad, MNIT Jaipur, and IIM Ahmedabad.

5.3 Industry Partners

Industry representation in the consortium is critical to ensure that all efforts are being directed towards market transformation, be it in terms of materials, design, services or the end-user demand. Industry partners would help assess market trends, potential, and bottlenecks of alternative policies, and assess the economic and adoption feasibility of programs. Further, some of the work by the consortium can provide credibility to new materials and technologies through simulation, testing, and expert reviews. Some of the potential industry partners include energy service companies, equipment and material manufacturers, real estate companies, and sector-specific associations such as the Hotel Association of India, etc. Schneider Electric India has already led the initiative in providing intellectual support for conceiving the initiative along with the promise of continued support to keep the initiative afloat during the initial period.

5.4 Other Partners and Stakeholders

Other potential partners include various multilateral and bilateral agencies and programs, such as:

i. United Nations Development Program, Global Environment Facility Trust Fund, Partnership to Advance Clean Energy – Research and Deployment
ii. Advocacy groups and NGOs – Alliance to Save Energy, Shakti Sustainable Energy Foundation, Usable Buildings Trust of UK
iii. Industry associations such as Alliance for Energy Efficient Economy
iv. Professional associations of architects, builders, and developers
v. Independent and reputed specialist institutions

More potential partners are list in Appendix F for reference

6 References

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UNEP, 2007, World Business Council for Sustainable Development (WBCSD)

7. Annexure

List of annexure documents

A. Letter of introduction from BEE for data collection
B. Data collection questionnaire
C. Web tool screenshots
D. Example of certification and plaque details
E. Benchmarking and performance based labeling report card
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A. Letter of introduction from BEE for data collection

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ऊर्जा दक्षता ब्यूरो
(भारत सरकार, विद्युत मंत्रालय)
BUREAU OF ENERGY EFFICIENCY
(Government of India, Ministry of Power)

New Delhi, the July 5th, 2011

Subject : Request to participate in nationwide building energy data collection effort.

The Bureau of Energy Efficiency (BEE) has initiated several regulatory and promotional measures for improvement of energy efficiency in the various sectors of the Indian economy. Among them, buildings, which account for about 30% of the total electricity supplied by the utilities, is one of the key thrust areas of BEE.

Under the **BEE-USAID Energy Conservation & Commercialization (ECO) programme,** the International Resources Group (IRG) with the support of its partners – M/s. Eliminate Carbon Emissions (ECE); institutional partners – Indian Institute of Management, Ahmedabad (IIM-A) and CEPT University; and industry partners – Schneider Electric (India) have taken up an initiative for expanding and eventually institutionalizing data collection efforts related to energy use in various commercial buildings.

This data collection effort will form the basis of strengthening the Star Labeling Scheme for buildings, using a robust and internationally recognized peer-group comparison method, which is critical to the development of this database.

This information can help the users and other stakeholders including builders, architects and code enforcing agencies to evaluate a building's energy efficiency and track improvements compared to other buildings. This is also critical for setting benchmarks that can be used for ECBC compliance, labeling of existing buildings, and recognizing the top performers through a systematic evaluation scheme.

As a prominent player in the commercial building sector we solicit your cooperation for partnership with us in helping us to evolve a framework for benchmarking the energy usage in commercial buildings in India. In keeping with this, you are requested to provide all the necessary and timely assistance to the data collection team, as this will help in analyzing the energy usage of commercial building at a national level after normalization for proper comparative analysis. The information collected under this initiative would not be divulged for any individual building but will focus on energy performance and benchmarking of the building stock. The Bureau of Energy Efficiency looks forward to your cooperation in the success of this important national initiative.

(Ajay Mathur)
Director General

स्वहित एवं राष्ट्रहित में ऊर्जा बचाएँ Save Energy for Benefit of Self and Nation
चौथा तल, सेवा भवन, आर० के० पुरम, नई दिल्ली - 110 066 वेबसाईट / Web-Site : www.bee-india.nic.in
4th Floor, Sewa Bhawan, R.K. Puram, New Delhi - 110 066 टेली/Tel : 26179699 (5 Lines) फैक्स/Fax : 91 (11) 26178352

B. Data collection questionnaire

Table 1: Building Information and Energy Data (to be kept Confidential)

Building Name:_____

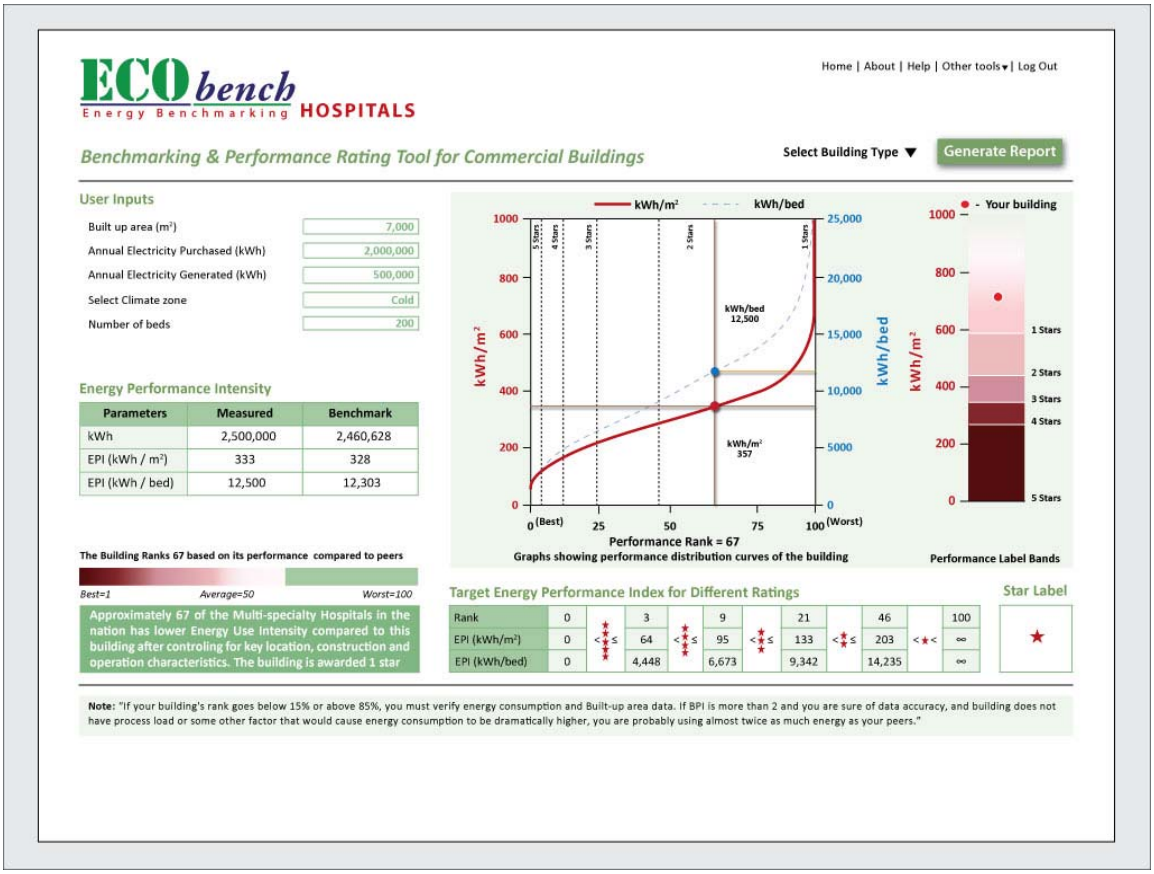
Primary Data			Year:2008- 09/2009-10
No.	**Item**		**Value**
1	Year of Building Construction		
2	Whether your building has received any Green Building Certification? Yes/No		
3	If you have received green building rating , specify the rating program		
1	Connected Load (kW) or Contract Demand (kVA)		
2	Peak Demand or Maximum Demand Indicated (MDI) (kW)		
3	Installed capacity: DG/ GG Sets (kVA or kW)		
4	a) Annual Electricity Consumption, purchased from Utilities (kWh)		
	b) Annual Electricity Consumption, through Diesel Generating (DG)/Gas Generating (GG) Set(s) (kWh)		
	c) Total Annual Electricity Consumption, Utilities + DG/GG Sets (kWh)		
5	a) Annual Electricity Cost, purchased from Utilities (Rs.)		
	b) Annual Electricity Cost generated through DG/GG Sets (Rs.)		
	c) Total Annual Electricity Cost, Utilities + DG/GG Sets (Rs.)		
6	Area of the building (exclude parking, lawn, roads, etc.)	a) Built Up area (sq. ft. or sq.m.)	
		b) Carpet Area (sq. ft. or sq.m.)	
		○ Conditioned area	
		○ Non Conditioned area	
7	No. of Floors in the Building		
8	Working hours (e.g. day working /24 hour working)		
9	Working days/week (e.g. 5/6/7 days per week)		
10	a) Office	Total no. of employees	
		Average .no. of persons at any time in office	
	b) Hotel	Type of Hotel (5 star ,4 star etc)	
		No. of guest rooms	
		Guest overnights in the year (% Occupancy)	
	C) Hospital	Type of Hospital (Govt, Multi-specialty etc)	
		Number of beds	
		Patient overnights in the year (% Occupancy)	
11	Installed capacity of Air Conditioning System	a) Centralized AC Plant (TR)	
		b) Packaged ACs (TR)	
		c) Window / Split ACs (TR)	
		d) Total AC Load (TR)	
12	Installed lighting load (kW)		
13	Equipment Load (kW)*		
14	Water consumption in the building	Water consumption in the year (exclude consumption for garden, lawn, etc.) (kilo liters)	
		Estimated hot water consumption in the year (kilo liters)	
15	Whether sub-metering of electricity consumption for Air Conditioning, Lighting, Plug Loads, etc. done: Yes/No		
16	HSD (or any other fuel oil used, specify)/Gas Consumption in DG/GG Sets (liters/cu. meters) in the year		
17	Fuel (e.g FO, LDO,LPG, NG) used for generating steam/water heating in the year (in appropriate units)		

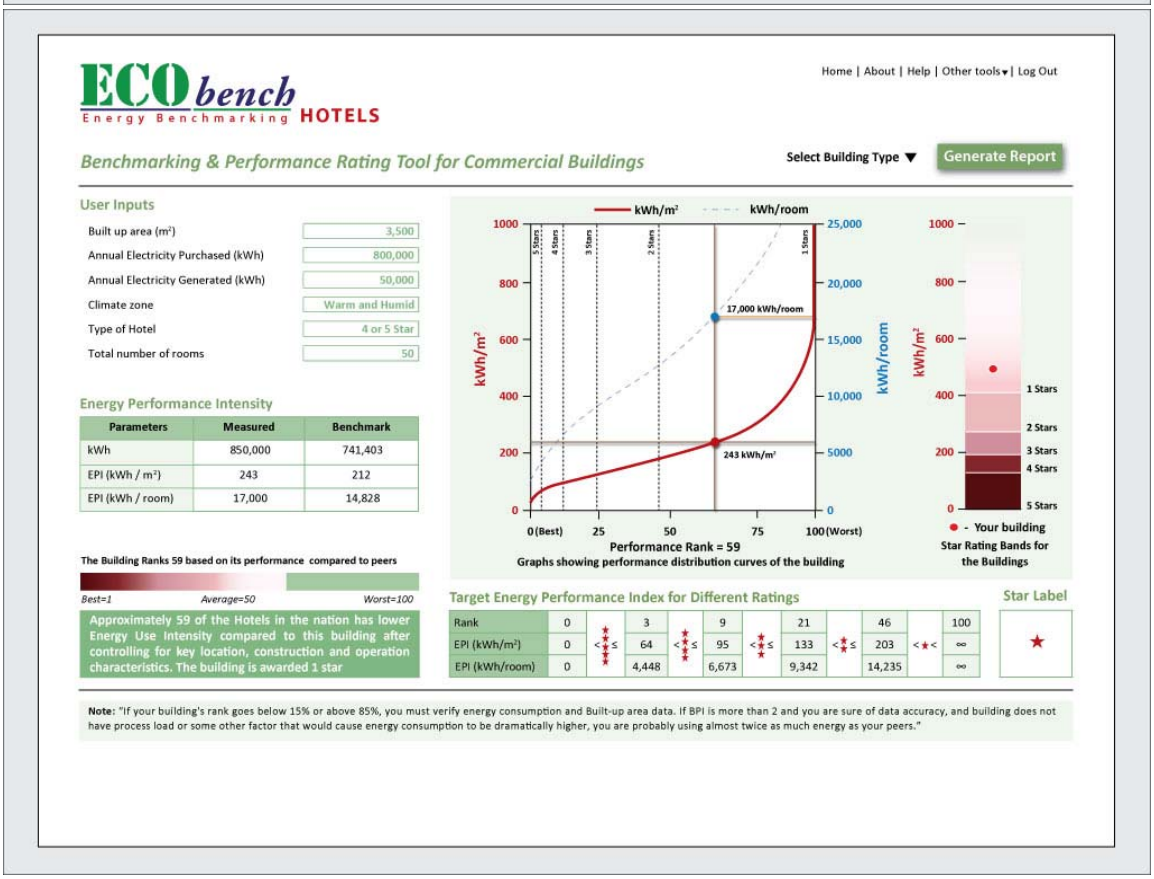
*In many cases, this can be gathered from the UPS system.

Table 2: Contact Details of the Organization and the Contact Person

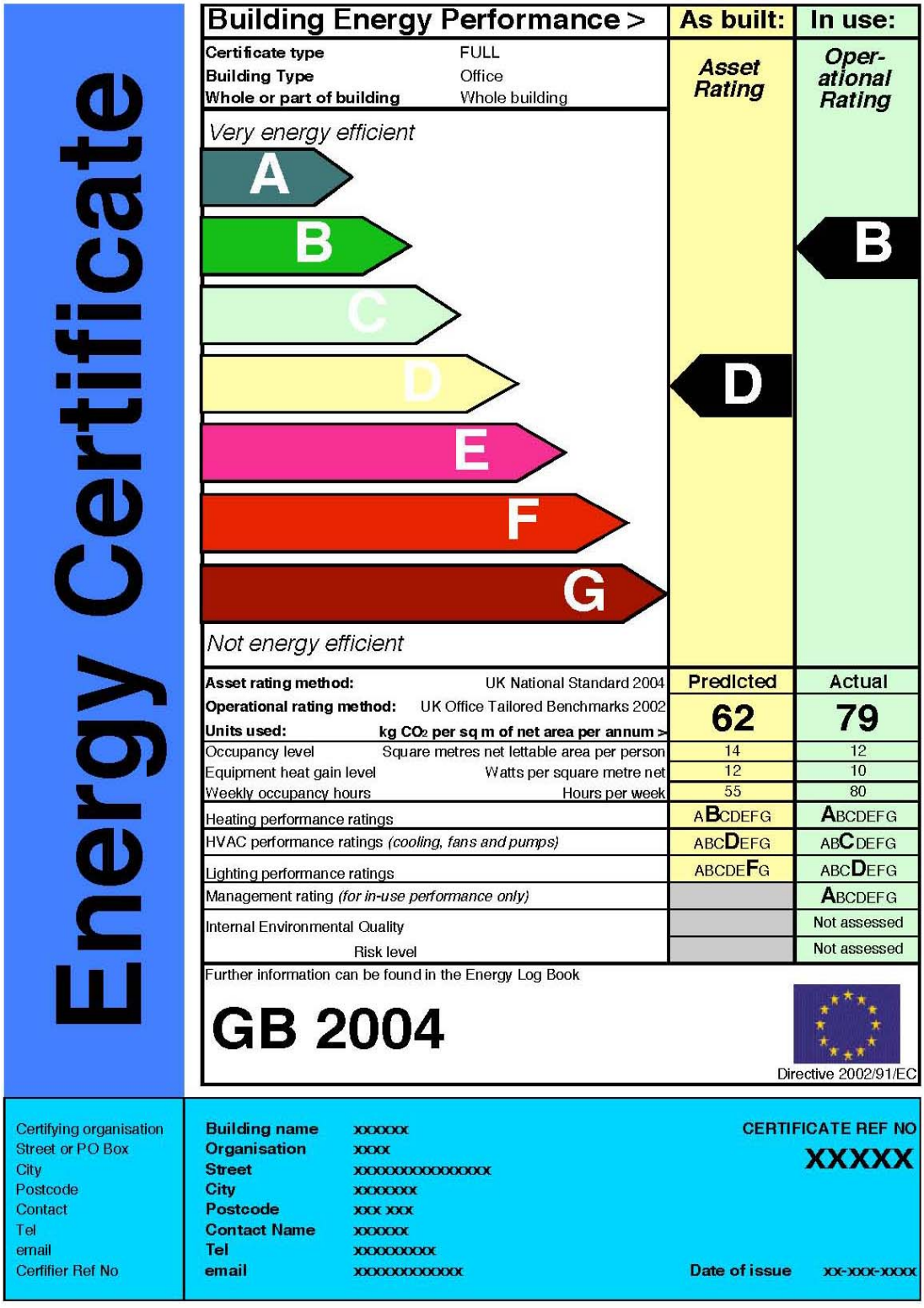
No.		Details
1	**Organization**	
a)	Name of the Organization	
b)	Postal Address	
c)	Phone No.	
d)	Name of the building	
2	**Contact Person**	
a)	Name & Designation	
b)	E-mail Address	
c)	Phone Nos.	

C. Web tool screenshots





D. Example of certification and plaque details



Energy Certificate

Building Energy Performance >	As built:	In use:
Certificate type: FULL Building Type: Office Whole or part of building: Whole building	*Asset Rating*	*Oper-ational Rating*
Very energy efficient A B C D E F G *Not energy efficient*	D	B
Asset rating method: UK National Standard 2004	Predicted	Actual
Operational rating method: UK Office Tailored Benchmarks 2002	62	79
Units used: kg CO_2 per sq m of net area per annum >		
Occupancy level — Square metres net lettable area per person	14	12
Equipment heat gain level — Watts per square metre net	12	10
Weekly occupancy hours — Hours per week	55	80
Heating performance ratings	ABCDEFG	ABCDEFG
HVAC performance ratings *(cooling, fans and pumps)*	ABCDEFG	ABCDEFG
Lighting performance ratings	ABCDEFG	ABCDEFG
Management rating *(for in-use performance only)*		ABCDEFG
Internal Environmental Quality		Not assessed
Risk level		Not assessed

Further information can be found in the Energy Log Book

GB 2004

Directive 2002/91/EC

Certifying organisation	**Building name**	xxxxxx	CERTIFICATE REF NO
Street or PO Box	**Organisation**	xxxx	XXXXX
City	**Street**	xxxxxxxxxxxxxxx	
Postcode	**City**	xxxxxxx	
Contact	**Postcode**	xxx xxx	
Tel	**Contact Name**	xxxxxx	
email	**Tel**	xxxxxxxxx	
Cerifier Ref No	**email**	xxxxxxxxxxxx	**Date of issue** xx-xxx-xxxx

E. Benchmarking and performance based labeling report card

Building ID	N/A	Building Type	Hotel
Address	14 B, Amravan Society Satellite, Ahmedabad, Gujarat	Date of Reporting	19th April'2011
		Data Period	April 2010 to March 2011
PIN Code	380015	Report Valid up to	19th April'2012

1. Input Summary

Building Detail

Type	Hotel
Sub Type	4 star or above
Built up Area (m^2)	3500
Climate	Warm & Humid
No. of Rooms	50

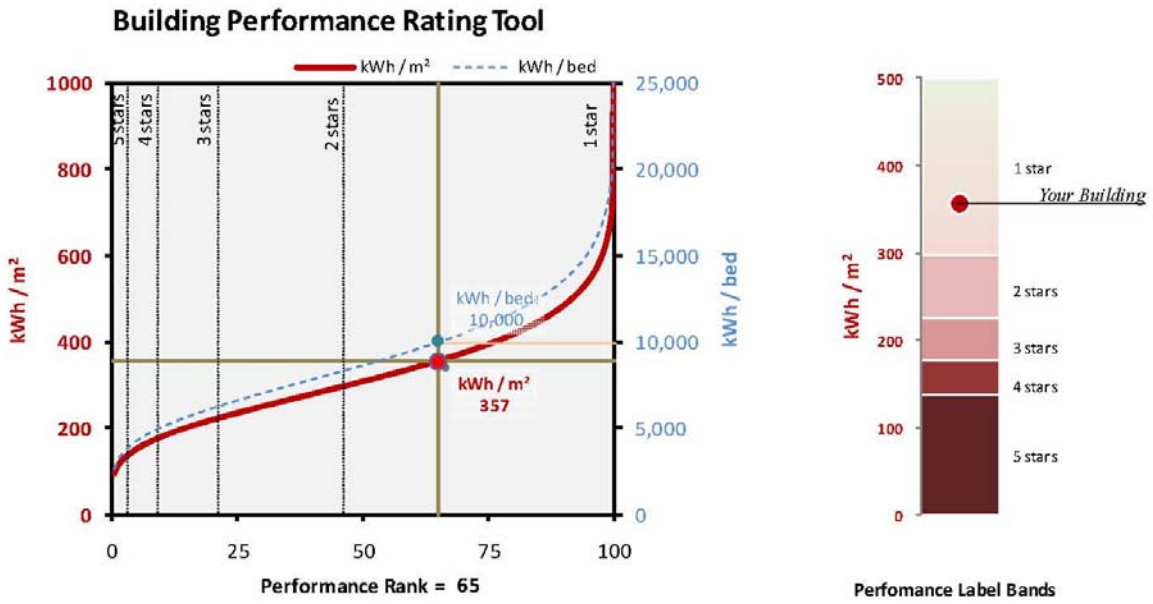
Annual Energy Use Summary

Purchased from Utility	800,000 kWh/m^2
Generated from DG/GG	50,000 kWh/m^2/room
Total Energy Consumed	850,000 kWh

Energy Performance Intensity

kWh/m^2	243
kWh/room	17,000

2. Comparison with National Benchmark



This Building	243 kWh/m^2 or 17,000 kWh/room
Performance rank	Top 59 percentile
National Average	212 kWh/m^2
Best Practice	64 kWh/m^2 or 4,453 kWh/room

The building is eligible for 1 star.

** Poor or Just Average Performance* *** Good Performance,* **** Very Good Performance*
***** Strong Performance (Best Practice)* ****** Exceptional Performance*

E. Benchmarking and performance based labeling report card

3. Evaluation

Energy Performance Intensity of this building is 243 kWh/m^2 or 17,000 kWh/room. The average Energy Performance Index of similar hotels in the national stock is 212 kWh/m^2. It consumes 14% more energy than the national average and is ranked among the top 59 percentile of hotel buildings. It is eligible for 1 star.

4. Targets

This table sets energy performance targets to achieve different star ratings for this building. For example, in order to achieve a 4 star rating, this building's EPI should fall between 94 and 64 kWh/m^2, or should rank among the top 9 percent in terms of energy performance. Note that these targets are specific to this building based on the input parameters and will vary for other buildings.

	Rank	EPI (kWh/m^2)
1 star	> 46	> 203
2 stars	> 21 and ≤ 46	> 134 and ≤ 203
3 stars	> 9 and ≤ 21	> 94 and ≤ 134
4 stars	> 3 and ≤ 9	> 64 and ≤ 94
5 stars	≤ 3	≤ 64

5. Remarks

"Please note that this is a preliminary / general assessment tool kit for building energy performance. Low energy consumption does not necessarily mean your building is efficient and high energy consumption does not always mean that it is inefficient. Many related factors need to be taken into account for an accurate evaluation such as number of computers, operating hours, presence of special building use and high energy use area and tenants, as well as internal environmental settings." *Ref: Summary sheet of Energy Smart Tool, Singapore*

If your building's rank is less than 15 or greater than 85, you must verify your input data. If the national average EPI is twice that of your EPI, and you are sure of data accuracy, and building does not have process load or some other factor that would cause energy consumption to be dramatically higher, you are probably using almost twice as much energy as your peers

6. Certification

Based on the conditions observed at the time of my visit to the building and supporting documents, I certify that the building input data contained in this statement is accurate.
The building should be awarded _____ Stars based on the official benchmarking Tool.

Signature of Certifying Professional
Name:

Stamp
Date:

7. Disclaimer

"The Benchmarking result as indicated above is subject to the data quality input by the User. Energy Sustainability Unit (ESU) does not warrant or represent that any outcome produced as a result of the use of the Tool is accurate, or will be the same as, or is indicative of the outcome of any official rating by ESU. In no event will the ESU be liable for any direct or indirect, special, incidental, tort, economical or consequential damage for negligence or any loss of profit, whether arising out of the use or inability to use the tool. Any outcome produced by the tool or any reliance there on, or otherwise. You must not make any representation to third parties based on any outcome produced as a result of the use of the Tool, and no license is granted to the use or reproduction of any ESU or trade mark or otherwise." *Ref: Summary sheet of Energy Smart Tool, Singapore*

F. List of potential partners for building performance initiative

AEEE	Technical
CWF/SSEF	IITs
GTZ	CII-GBC
Tata Trust	TERI
Infosys Foundation	ISHRAE
USAID	Infosys
US DOE	Tata
Policy	Wipro
BEE	Real Estate Service Providers
EESL	Jones Lang LaSalle
CERC/SERCs	Cushman Wakefield
NBCC	CB Richard Ellis
MUD	Sodexho
Labor/HRD	Energy Service Companies
Statistical	Dalkia Energy Services
NSSO	Johnson Controls
MOSPI	Design Community
Indian Statistical Institute	Council of Architecture
IIM-A	Indian Institute of Architects
CEA	

G. Useful definitions from various benchmarking programs

General Definitions (Source: Energy Performance of Building Directive, Europe)

Building	A roofed construction having walls, for which energy is used to condition the indoor climate.
Technical building system	Technical equipment for the heating, cooling, ventilation and lighting or for a combination of a building or building units.
Energy performance of a building	The calculated or measured amount of energy needed to meet the energy demand associated with a typical use of the building which includes energy used for heating, cooling, ventilation, hot water and lighting.
Energy from renewable sources:	Energy from renewable non fossil sources namely wind, solar, aero thermal, geothermal, hydro thermal and ocean energy, hydro power, biomass, landfill gas, sewage treatment plant gas and bio gases.
Major renovation	The renovation of a building where: the total cost of renovation is higher than 25% of the value of the building excluding the value of land on which it is executed and more than 25% of the surface of the building envelope undergoes renovation.
Building envelope	The integrated elements of a building which separate its interior from the outdoor environment.
Building unit	A section, floor or apartment within a building which is designed or altered to be used separately
Building element	A technical building system or an element of the building envelope.
Energy performance certificate	A certificate recognized by a Member state or by a legal person designated by it which indicates the energy performance of a building or building unit.
Energy Performance & renovation	Major renovations should provide an opportunity to take cost-effective measures to enhance energy performance of the buildings. Given the long renovation cycle for existing buildings, new and existing buildings that are subject to major renovation should meet minimum energy performance requirements adapted to the local climate. It should be possible to limit the minimum energy performance requirements to the renovated parts that are most relevant for the energy performance of the building.
Energy & Existing building	Minimum energy performance requirements are set for building elements that form part of the building envelope and that has a significant impact on the energy performance of the building envelope when they are replaced or retrofitted, with a view to achieving cost-optimal levels.

G. Useful definitions from various benchmarking programs

Benchmark:	A point of reference for measurement; a defined level of performance used as a reference for comparisons. Benchmarks can be based on averages or percentiles of real performance. On the other hand, they can be based on policy –driven objectives such as “net zero carbon”

Space Type of Definitions (Source: Energy Star, US)

Bank/Financial Institution	Space used for financial services. Relevant businesses include bank branches, bank headquarters, securities and brokerage firms. The total gross floor area should include all supporting functions such as vaults, kitchens used by staff, lobbies, atria, conference rooms and auditoria, fitness areas for staff, storage areas, stairways, elevator shafts, etc.
Courthouse	Space used for federal, state, or local courts and associated office space. The total gross floor area should include all supporting functions such as temporary holding cells, kitchens used by staff, lobbies, atria, conference rooms and auditoria, fitness areas for staff, storage areas, stairways, elevator shafts, etc.
Data Center	Spaces specifically designed and equipped to meet the needs of high density computing equipment such as server racks, used for data storage and processing. The total gross floor area should include all supporting functions like raised floor computing space, server rack aisles, storage silos, control console areas, battery rooms, mechanical rooms for cooling equipment, administrative office areas, elevator shafts, stairways, break rooms and restrooms.
Dormitory / Residence Hall	Buildings associated with educational institutions or military facilities which offer multiple accommodations for long-term residents. The total gross floor area should include all supporting functions such as food service facilities, laundry facilities, meeting spaces, exercise rooms, health club/spas, lobbies, elevator shafts, storage areas stairways, etc.
Hospital (Acute Care & Children’s)	Spaces used from 20,000 to 5 million square feet in total gross floor area. These facilities provide acute care services intended to treat patients for short periods of time for any brief but severe medical condition, including emergency medical care, physician's office services, diagnostic care, ambulatory care, and surgical care.

G. Useful definitions from various benchmarking programs

Hotel	Buildings that rent overnight accommodations on a room/suite basis, typically including a bath/shower and other facilities in guest rooms. The total gross floor area should include all interior space, guestrooms, halls, lobbies, atria, restaurant space, conference and banquet space, health clubs/spas, indoor pool areas, and laundry facilities, stairways, mechanical rooms, storage areas, offices, etc.
House of Worship	Buildings that are used as places of worship. This includes churches, temples, mosques, synagogues, meetinghouses, or any other buildings that primarily function as a place of religious worship. The rating applies to worship facilities that have 4,000 seats or fewer.
K-12 School	Space used as a school building for Kindergarten through 12th grade students. This does not include college or university classroom facilities and laboratories, or vocational, technical, or trade schools. The total gross floor area should include all supporting functions such as administrative space, conference rooms, kitchens used by staff, lobbies, cafeterias, gymnasiums, auditoria, laboratory classrooms, portable classrooms, greenhouses, stairways, atria, elevator shafts, small landscaping sheds, storage areas, etc
Medical Office	Medical Office applies to facility space used to provide diagnosis and treatment for medical, dental, or psychiatric outpatient care. The total gross floor area should include all supporting functions such as kitchens used by staff, laboratories, lobbies, atria, conference rooms and auditoria, fitness areas for staff, storage areas, stairways, elevator shafts, etc.
Multifamily Housing	Space type as a residential building equal to or larger than 2 units. Multifamily space types include all square footage in the residential units, common areas, and unconditioned space (boiler room). Occupants of Multifamily housing can include tenants, cooperators, and/or individual owners.
Wastewater Treatment Plant	Facility that is designed to treat municipal wastewater. Treatment processes may include biological, chemical, and physical treatment. This space type is best applied to wastewater treatment facilities of 150 MGD or smaller.
Office	Office applies to facility spaces used for general office, professional, and administrative purposes. The total gross floor area should include all supporting functions such as kitchens used by staff, lobbies, atria, conference rooms and auditoria, fitness areas for staff, storage areas, stairways, elevator shafts, etc.

G. Useful definitions from various benchmarking programs

Parking	Space type is intended for any area connected to the building that is used for parking vehicles. This includes parking lots, fully enclosed parking structures, and unenclosed parking structures that are open on all sides and may or may not include roof parking.
Retail Store	Space used to conduct the retail sale of consumer product goods. Stores must be at least 5,000 square feet and have an exterior entrance to the public. The total gross floor area should include all supporting functions such as kitchens and break rooms used by staff, storage areas, administrative areas, elevators, stairwells, etc.
Senior Care Facility	It applies to individual buildings and campuses of buildings that house provide care and assistance for elderly residents. The total gross floor area of a Senior Care Facility should include all activities such as individual rooms or units, wellness centers, exam rooms, community rooms, small shops or service areas for residents and visitors, staff offices, lobbies, atria, cafeterias, kitchens,
Supermarket	Space type applies to facility space used for the retail sale of food and beverage products. The total gross floor area should include all supporting functions such as kitchens and break rooms used by staff, storage areas (refrigerated and non-refrigerated), administrative areas, stairwells, atria, lobbies, etc.
Swimming Pool	Swimming Pool applies to heated swimming pools that operate on the premises and on the same energy-use meter as the primary facility. This category applies to any heated swimming pools located inside or outside of the facility. Swimming pools are categorized by size, and whether they are an indoor or outdoor pool.
Warehouse	Warehouse applies to unrefrigerated or refrigerated buildings that are used to store goods, manufactured products, merchandise or raw materials. The total gross floor area of Refrigerated Warehouses should include all temperature controlled areas designed to store perishable goods or merchandise under refrigeration at temperature below 50°F.
Water Treatment & Distribution Utility	A water treatment and distribution utility applies to water distribution facilities designed to pump and distribute drinking water through a network of pipes. Depending on the water source (ground or surface) a water utility may or may not contain a treatment process.

H. Comparison of International Benchmarking Tools

List of Benchmarking Programs Referred

1. Energy Smart, Singapore
2. Portfolio Manager, Energy Star
3. Energy Concept Adviser, Europe
4. NABERS, Australia
5. Labs 21, US Department of Energy

Table of Contents

1.1 Program Administration

	Energy Smart	Portfolio Manager-Energy Star	Energy Concept Adviser -IEA	NABERS	Labs21
	Singapore	United States	Europe	Australia	US Department of Energy
Developed By					
	Energy Sustainability Unit (ESU) of the National University of Singapore (NUS) and the National Environment Agency (NEA)supported by European Union through the EU-ASEAN Energy Facility, National Environment Agency of Singapore and Jurong Town Corporation Singapore.	U.S. Environmental Protection Agency (EPA) program that focuses on improving energy performance in buildings as a method of reducing greenhouse gas (GHG) emissions.	The International Energy Agency (IEA) Energy Conservation in Buildings and Community Systems as per One of those international projects is Annex 36 - Energy Retrofit of Educational Buildings.	The Australian Dept. of Environment and Heritage (DEH).	Cosponsored by the U.S. Environmental Protection Agency (EPA) and U.S. Department of Energy (DOE).
Managed By					
	Energy Sustainability Unit (ESU) of the National University of Singapore (NUS)	Energy Star	Fraunhofer- Institute for Building Physics, Stuttgart.	NSW (Office of Environment and Heritage) Government	Voluntary team of nine members (EPA, Lawrence Berkeley National Laboratory, US Department of Energy & National Renewable Energy Laboratory)
Tool initiated in the year					
	Year 2005	-	Year 2004	March 2005	-
Type of Building that can be rated in the Benchmarking Tool					
	1. Hotel 2. Office 3. Retail Mall	1. Courthouse 2. Data Center 3. Hospital (acute care and childcare's) 4. Hotel 5. House of Worship 6. K–12 School 7. Medical Office 8. Municipal Waste water Treatment 9. Bank/Financial Institution 10. Warehouse 11. Supermarket 12. Senior Care Facility 13. Retail Store 14. Residence Hall/Dormitory 15. Plant 16. Office	Retrofitting of Educational Buildings	1. Hotels 2. Offices 3. Retail 4. Homes 5. Schools 6. Hospital 7. Transport	1. Laboratories
Cost of Rating					
Validity					
	Not mentioned (approx 1 year)	Validation For 12 Months	Not mentioned	Expires 12 months after date of rating	Not Mentioned
Main Application : Operational Phase, when building is completed & occupied. Usually 12 months of operational data is required.					

1.2 Vision for the Program

	Energy Smart	Portfolio Manager-Energy Star	Energy Concept Adviser -IEA	NABERS	Labs21
	Singapore	United States	Europe	Australia	US Department of Energy
	Aim				
	It aims to grant recognition for building energy efficiency. It enables facility managers to set target and work towards improving energy efficiency by effectively employing the resources.	It allows you to track and assess energy and water consumption across your entire portfolio of buildings in a secure online environment.	It identifies the energy retrofit measures of educational buildings as per Annex 36. The gained know-how shall be used in exemplary retrofit projects in the participating countries.	It measures environmental performance against the impact of various categories. It helps to recognize the accountability and responsibility for commercial building owners.	It helps minimize overall environmental impacts, protect occupant safety, optimize whole building efficiency on a life-cycle basis, establish goals, track performance, and share results .
	Benefits of the program				
	1. It can assist in tracking the building progress over time. 2. It enables facility managers to set target and work towards improving energy efficiency in the long run by effectively employing the resources. 3. It will signify lower operating energy costs and project an environmentally responsible image. 4. It helps to reduce CO2 emission and consumption of fossil fuels. 5. This also results in lower pressure on infrastructural demand and cost. 6. It helps to achieve energy savings at the national level.	1. Manage Energy and Water Consumption for all Buildings. 2. Rate Building Energy Performance 3. Estimate Your Carbon Footprint 4. Set Investment Priorities 5. Verify and Track Progress of Improvement Projects 6. Gain EPA Recognition 7. Related Tools	1. To provide tools and guidelines for decision makers and designers to improve the learning and teaching environment of educational facilities through energy- efficient retrofitting. 2. To support the decision makers in evaluating the efficiency and acceptance of available concepts. 3. To give recommendations on how to operate the retrofitted buildings. 4. To promote energy- and cost-efficient retrofit measures	1. Provide separate ratings for the different stakeholders within a building (such as landlords and tenants) where appropriate. 2. Provide an explicit and consistent rating system methodology, with a clear performance-based structure and methodologies. 3. Allow for voluntary self-assessment, with the option of seeking a certified rating from an accredited provider if desired. 4. Use measured quantities as the primary means of assessment. 5. Contain appropriate adjustments for factors such as climate and occupancy patterns.	1. Public Recognition as an industry leader committed to environmental excellence. 2. Training and technical assistance from experts around the country. 3. Networking opportunities with other industry professionals at training workshops and an annual conference. 4. Web-based tools to help support new approaches to laboratory design and operation. 5. Working groups actively pursuing sustainable solutions with a variety of lab-intensive industries.
	Future Developments				
	Hospitals Schools Industrial Buildings Shopping Mall	Additional Building Space Benchmarks	Educational Buildings	Refrigerants Storm water run off & pollution Sewage Landscape Diversity	Laboratories

1.3 Pre requisites

	Energy Smart	Portfolio Manager-Energy Star	Energy Concept Adviser -IEA	NABERS	Labs21
	Singapore	United States	Europe	Australia	US Department of Energy
	Criteria				
	1. Physical Characteristics • Gross Floor Area using Air Conditioned space • Primary Space • Secondary Space 2. Energy Source • Electricity should be main source of energy • Electricity meters must cover 365+_30 days • Readings should be recorded, simulated or calculated values are not acceptable. 3. Occupancy Characteristics • Occupancy Rate • Occupancy Hours • Building Occupancy • Occupant Density	1. Gross Floor Area 2. Operating Hours 3. Operating Computers 4. Workers on main shift 5. Licensed Bed 6. Floors Rooms 7. Sheets 8. Exterior Entrance 9. IT Energy Meter 10. No. of Residents	1. Pre requisites are the case studies for retrofitting measures of school.	1. Energy Consumption Data • Utility Bills of all source of energy used in the last 12 months latest bill must not be more than 4 months old. • For Tenancy Rating • For Base Building Rating • For Whole Building Rating 2. Net lettable Data • Layout Plan • Lease Documents • Tenancy Rating • Base or Whole Building Rating 3. Number of Computers 4. Hours of Occupancy	1. Total Area of conditioned & Non conditioned space 2. Net area of laboratory spaces 3. Weather 4. Lab Type :chemical, biological,physical 5. Lab Use : research, teaching, manufacturing. 6. Occupancy Schedule 7. Ventilation Rates 8. Equipment Loads

1.3 Pre Requisites / Eligibility Criteria for Rating Building Energy Performance: Operating Characteristics

Portfolio Manager asks you to enter data for key operating characteristics for each space in your building. There are minimum and maximum thresholds for these values which differ by space type. These limits are designed to make sure that your building falls into an operation pattern consistent with that of the peer group used for comparison.

	Gross Floor Area (ft2)	Operating Hours	Personal Computers	Workers on main shift	Licensed Beds (#)	Floors (#)	Rooms (#)	Seats (#)	Exterior Entrance	IT Energy Meter	Number of Residents
Bank/Financial	≥ 1,000	30 ≤ H/W ≤ 168	# PCs ≥ 1	≥ 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Courthouse	≥ 5,000	30 ≤ H/W ≤ 168	# PCs ≥ 1	≥ 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Data Center	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	≥ 11 Months	N/A
Hospital Acute Care	20,000 ≤ ft² ≤ 5,000,000	N/A	N/A	N/A	16 ≤ Beds ≤ 1510	1 ≤ Floors ≤ 40	N/A	N/A	N/A	N/A	N/A
Hotel	≥ 5,000	N/A	N/A	≥ 1	N/A	N/A	≥ 1	N/A	N/A	N/A	N/A
House of Worship	≥ 1,000	H/W ≥ 0	#PCs ≥ 0	N/A	N/A	N/A	N/A	25 ≤ Seats ≤ 4000	N/A	N/A	N/A
K-12 School	≥ 5,000	N/A	#PCs ≥ 0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Medical Office	≥ 5,000	30 ≤ H/W ≤ 168	N/A	≥ 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Office	≥ 5,000	30 ≤ H/W ≤ 168	# PCs ≥ 1	≥ 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Residence/Dormitory	≥ 5,000	30 ≤ H/W ≤ 168	N/A	N/A	N/A	N/A	≥5	N/A	N/A	N/A	N/A
Retail	≥ 5,000	30 ≤ H/W ≤ 168	Registers ≥ 1 #PCs ≥ 0	≥ 1	N/A	N/A	N/A	N/A	YES	N/A	N/A
Senior Care Facility	≥ 5,000	N/A	#PCs ≥ 0	≥ 0	N/A	N/A	N/A	N/A	N/A	N/A	≤ Resident Capacity
Supermarket	≥ 5,000	30 ≤ H/W ≤ 168	N/A	≥ 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Warehouse	≥ 5,000	30 ≤ H/W ≤ 168	N/A	≥ 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A

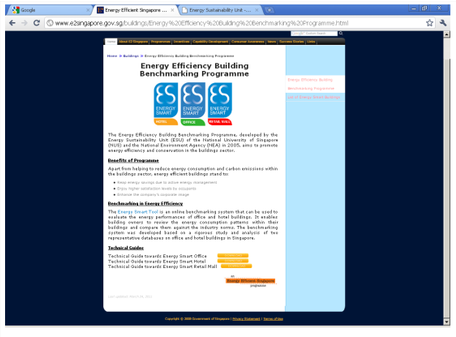
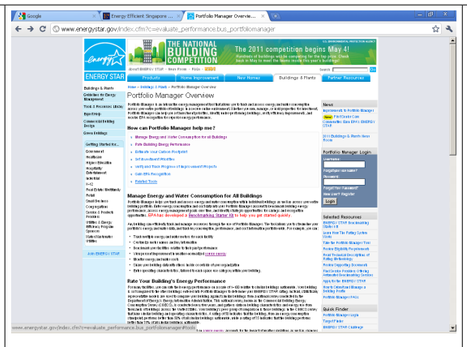
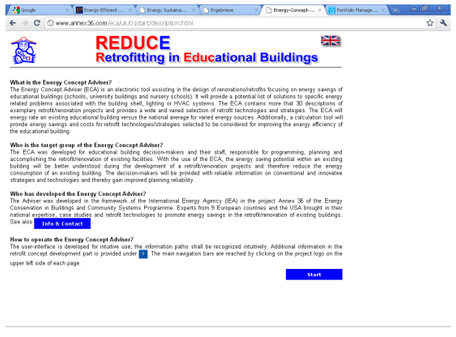
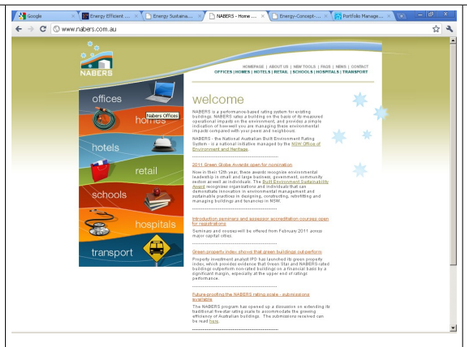
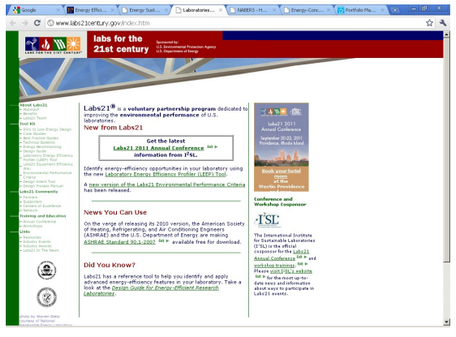
Waste water Treatment Plant Requirements:

Criteria	Average influent flow	Average influent BOD5	Average effluent BOD5	
	MGD > 0.6	30 < mg/liter < 1000	mg/liter > 0	

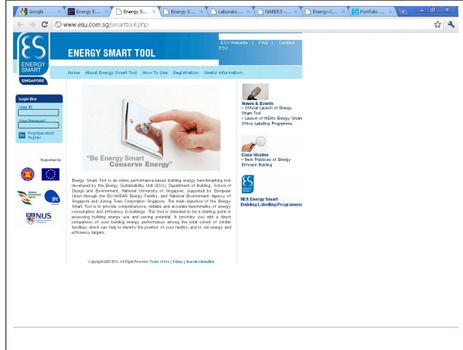
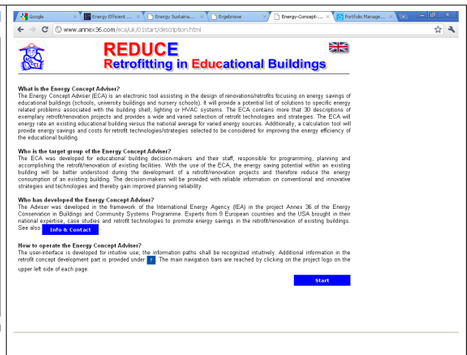
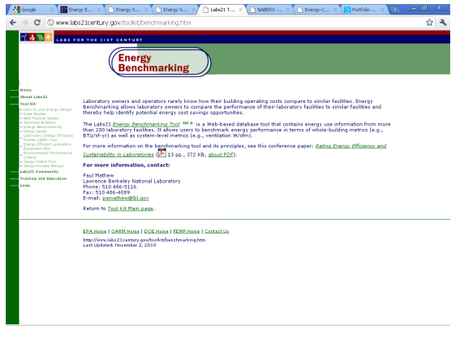
1.4 Data Collection

	Energy Smart	Portfolio Manager-Energy Star	Energy Concept Adviser -IEA	NABERS	Labs21
	Singapore	United States	Europe	Australia	US Department of Energy
	1. General Information 2. Thermal Comfort 3. Visual Comfort 4. Indoor Air Quality 5. Total Building Performance 6. Questionnaire for offices 7. Questionnaire for Hotel	1. The building street address, year built, and contact information. 2. The building gross floor area and key operating characteristics for each major space type. 3. 12 consecutive months of utility bills for all fuel types used in the building. 4. Data Collection Worksheet	1. Data was shared amongst the participants of Annex 36-Energy Retrofit of Educational Buildings.	1. A category of data used in a rating assessment. Data types for NABERS Energy and Water for offices ratings are: 2. area 3. hours 4. number of computers 5. energy consumption: electricity gas fuel oil 6. water consumption: externally supplied potable water externally supplied recycled water water from on-site sources. 7. Data Collection Guidance Document 8. Other Information self assessment page	1. Gross area 2. Lab area 3. Weather 4. Lab type 5. Lab use 6. Occupancy schedule 7. Required ventilation rates 8. Equipment loads 9. Reference Guide
	Energy Consumption Measured in Units				
	kWh/m^2 /year (Energy Usage Intensity EUI)	k Btu / ft^2 / yr (Site) k Btu / ft^2 / yr (Source)	kWh/m^2a (electrical energy) l/m^2a (water consumption) kWh/m^2a (gas)	kWh (electrical use) kWh (energy use) MJ/m^2 (energy density) GJ (gas) kgCO2/m^2 per annum (green house emissions)	kWh/sf-yr (electric) BTU/sf-yr (site) BTU/sf-yr (source) Utility $/sf-yr
	Method of Collection				
		Phone Survey			

2.1Main Page: Overview of the Benchmarking Tool

	Energy Smart	Portfolio Manager-Energy Star	Energy Concept Adviser -IEA	NABERS	Labs21
	Singapore	United States	Europe	Australia	US Department of Energy
	1. [Top Bar] : What is Energy efficiency building Benchmarking ? 2. Benefits of Program 3. Benchmarking in Energy Efficiency **(Energy Smart Tool)** 4. Technical Guides : Office Hotel Retail Mall	1. [Top Bar] : Portfolio Manager Over view 2. How can Portfolio Manager Help me? **3. Portfolio Manager Log-in** 4. [Side Bar] : Benchmarking Starter Kit Portfolio Manager Reference Guide Review Eligibility Requirement Portfolio Manager FAQ New development	1. [Top Bar] : What is energy Concept Adviser? 2. Who is the Target Group? 3. Who has developed Concept Adviser? (info & contact link) 4. How to operate the Energy Concept Adviser?	1. [Top Bar] : About Us FAQ New Tools News Contact 2. Introduction seminars and assessor accreditation courses open for registrations 3. Green property index shows that green buildings out-perform 4. Future-proofing the NABERS rating scale - submissions available 5. Victorian buildings get NABERS rating boost 6. Commercial Building Energy Efficiency Disclosure 7. NABERS Energy and Water for offices: Rules for collecting and using data 8. [Side Bar] : Offices, Retail, School, Hospital, Hotels, Homes, Transport	1. [Top Bar] : New from Labs21 2. News you Can Use 3. Did you Know? Design guide 4. [Side Bar] : About Labs 21 Tool Kit **Energy Benchmarking** Efficiency Profiler Tool Environmental Performance Criteria Case Studies Best Practices Technical Bulletins Labs21 Community Partners, Supporters Center of Excellence Network, Training & Education Conference Workshops Resources Industry Events & Awards, News
Visual Interface:					

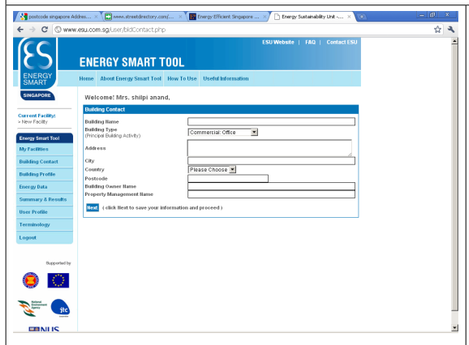
2.2 Second Page : About the Benchmarking Tool

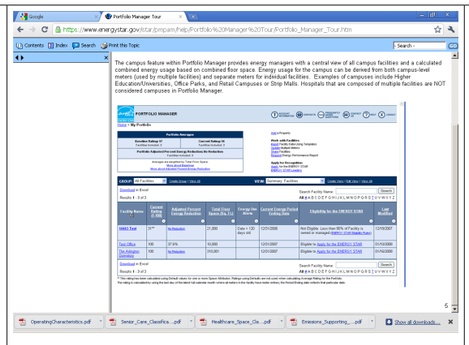
	Energy Smart	Portfolio Manager-Energy Star	Energy Concept Adviser -IEA	NABERS	Labs21
	Singapore	United States	Europe	Australia	US Department of Energy
	1. [Top Bar] : Energy Smart Tool 2. About Energy Smart Tool 3. How to Use? 4. Registration 5. Useful Information 6. ESU Website 7. FAQ 8. Contact 9. [Side Bar L] : Log in 10. [Side Bar R] : News & Events Case Studies (Best Practices of Energy efficient building)	1. [Top Bar] : Create a Portfolio Manager account 2. FAQ, Contact US & Help 3. What's New in Portfolio Manager 4. New Features 5. About Portfolio Manager 6. Technical Guides: Hospital Office Hotel Retail 7. Success through Eenergy Star 8. [Side Bar R] : Log-in News & Events Case Studies (Best Practices of Energy efficient building)	1. Obtain recommendations for specific problems in your building : Recommendations 2. Study more than 30 retrofitted buildings and retrofit measures: Case studies 3. Compare your building's consumption to national data: **Performance Rating** 4. Develop an energy efficient retrofit concept for your building : Retrofit Concept 5. Programs and methods to analyze your building performance :Utilities 6. Any questions : Info & Contact	1. [Top Bar] : **NABERS Rating Calculator** View Rated Office Buildings Commitment Agreement Information Find an Assessor Become an Assessor NABERS Assessor Login 2. [Side Bar] : NABER Office Energy About Us Contact Rate your Premise Improve your Rating Resources & News	**1. Energy Benchmarking Tool** 2. Contacts 3. [Side Bar] : About Labs21 Tool Kit Community Training & Education 4. Links to other website : Lab Rating **Data Query**
Visual Interface					

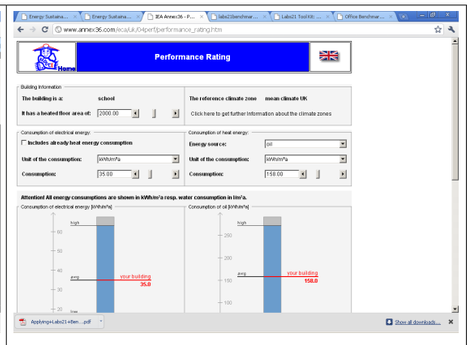
2.3 Benchmarking Tool : Input Parameters

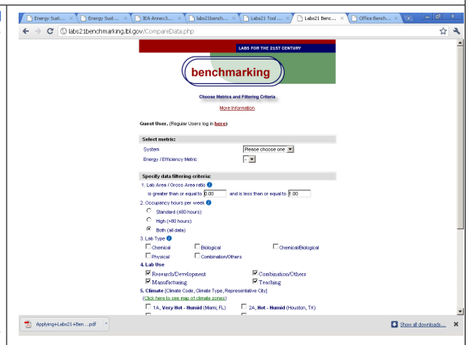
	Energy Smart	Portfolio Manager-Energy Star	Energy Concept Adviser -IEA	NABERS	Labs21
	Singapore	United States	Europe	Australia	US Department of Energy
	1. [Top Bar] : Log-In 2. Before you Start (Prerequisite) 3. Terms & Condition (I Agree Page) 4. Registration Form 5. Input Parameters Building Contact_a Building Contact_b Building Profile Energy Data 6. Summary & Results	1. [Top Bar] : Log -In 2. Add a new Facility 3. Select Property Type & enter general facility information 4. Enter Space Use Data 5. Enter Energy Use Data 6. Create Custom groups **7. View & Interpret results** 8. Request for energy Performance report in Excel Format.	1. [Top Bar] : Building Information Type (NOT Changing) Area Climate 2. Consumption of Electrical Energy Consumption Unit of Consumption 3. Consumption of Heat Energy Unit of Consumption Consumption **4. Consumption Graph:locating your building's consumption** 5. National Survey Consumption **6. Links to other websites**	1. [Top Bar] : Terms & Conditions (I agree) 2. Building Details 3. Rated Area Area Occupancy 4. Rating Type Type of Rating 5. Link to : Energy Water Indoor Environment Waste **6. Results**	1. [Top Bar] : Log-in (as a guest User) 2. Select Metric 3. Specify Data Filtering Criteria Lab Area Occupancy Hours/Week Lab Type Lab Use 4. Climate 5. Measured & Estimated Data

Visual Interface

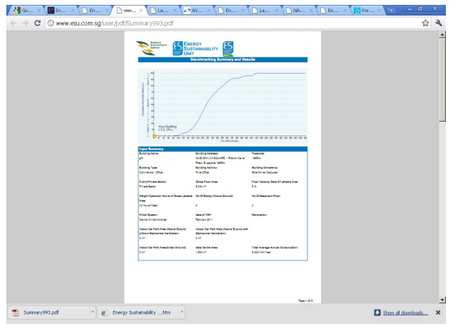
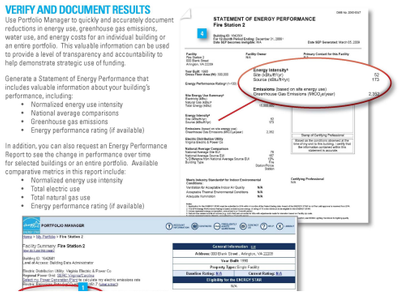
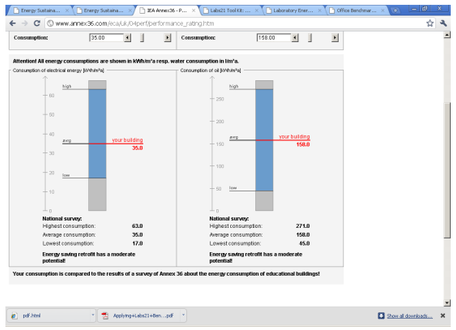
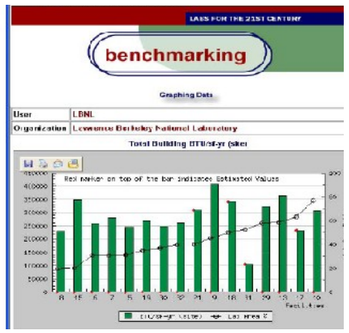








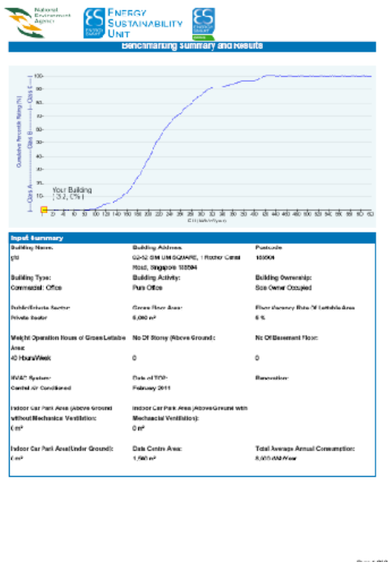
2.4 Benchmarking Tool : Output Parameters

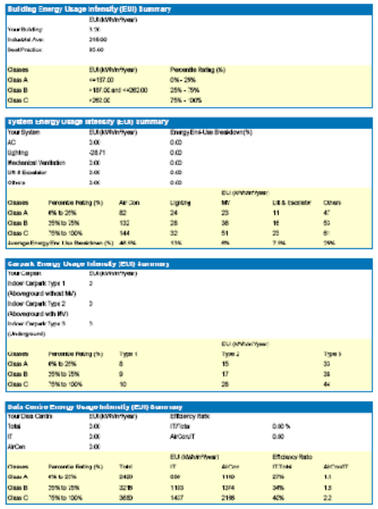
	Energy Smart	Portfolio Manager-Energy Star	Energy Concept Adviser -IEA	NABERS	Labs21
	Singapore	United States	Europe	Australia	US Department of Energy
	1. [Top Bar]: Cumulative Percentile Rating (Graph) 2. Input Summary 3. Building Energy Usage Intensity Summary 4. System Energy Usage Intensity Summary 5. Car park Energy Usage Intensity Summary 6. Data Center Energy Usage Intensity Summary 7. Evaluation of Benchmarking Results 8. Remarks 9. Disclaimer	1. [Top Bar]: Results are in the form of Statement 2. Building ID, Time duration 3. Facility or the type Gross Floor Area, Year Built 4. Site Energy Usage Summary Electricity (k Btu) Natural Gas (k Btu)4 Total Energy (k Btu) 5. Energy Intensity Site (k Btu/ft2/yr) Source (k Btu/ft2 yr) 6. Emissions Green House Gas 7. National Average Comparison 8. Meets Industry Standards	1. [Top Bar]: Consumption of Electrical Energy (kWh/m2a) 2. Results are in the form of Graph 3. Consumption Of Oil (kWh/m2a) 4. It also defines the building has moderate, average or high potential 5. States the existing benchmark, easy to compare your own results	1. [Top Bar] : Date Site Climatic Zone 2. Rating Type 3. Rated Area 4. Hours of Occupancy 5. Links to other TAB: Energy Water Indoor Environment Waste 6. [Side Bar] : Help Reset Form Terms & Conditions Print/Results	1. [Top Bar] : Results are presented in graphical format 2. Graph of Annual Site Energy Use verses gross area ratio 3. Comparing your facility with others export results
Visual Interface					
	 Please refer Summary Sheet	 Please refer Refrence Guid			
Reference					
	http://www.esu.com.sg/smarttool.php	*http://www.energystar.gov*	*http://www.annex36.com/eca/uk/01start/menu.h*	*http://www.abgr.com.au*	*http://www.labs21century.gov*

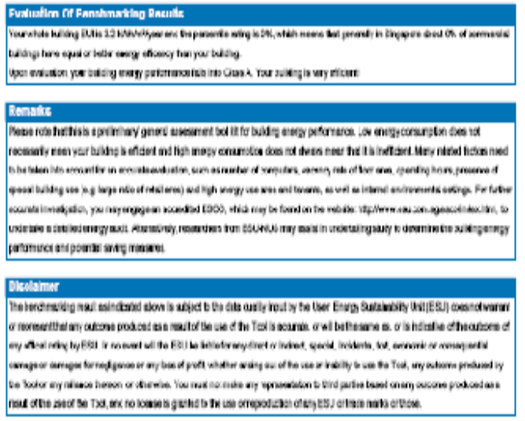
Note: 1. Font: Blue indicate link in the website

2.5 Reports/ Summary/ Statement of Performance

Energy Smart, Singapore







Portfolio Manager, Energy Star US.

2.6 Frequently Asked Questions

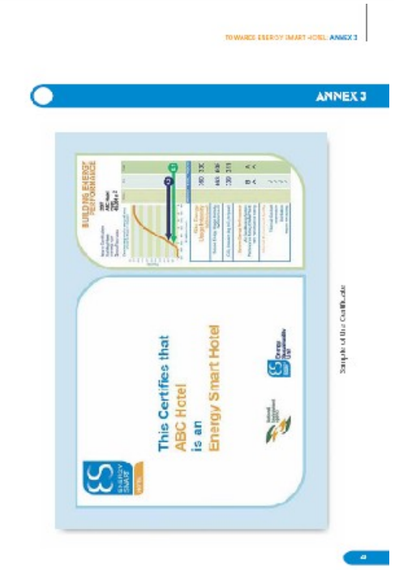
	Portfolio Manager-Energy Star	Labs21	NABERS
	United States	US Department of Energy	Australia
	1. How does the tool calculate source energy? 2. Can this tool be used for LEED-EB?What is the difference between LEED and ENERGY STAR? 3. What types of buildings can be evaluated with Portfolio Manager? 4. Can I apply to earn the ENERGY STAR plaque for an office building that isn't 100% occupied? 5. How can I qualify and apply for the ENERGY STAR label for buildings? 6. What constitutes a single structure? What if multiple buildings are connected via hallways, common spaces, etc? 7. Are there costs involved? 8. What information do I need to enter into Portfolio Manager to get an energy performance rating for my building? 9. How long is the ENERGY STAR label valid on a building? 10. What should be included in the gross square footage of my facility? 11. How were the ENERGY STAR criteria for buildings derived?	1. What are the data sources for the Labs21 tool? 2. Does the Labs21 tool include laboratory buildings from the CBECS database? 3. Is the Labs21 data set a statistically representative sample of all U.S. laboratory buildings? 4. Are the energy use data in the tool measured or estimated? 5. Is my data secure? 6. Does the Labs21 tool provide a rating between 1 and 100, like the Energy Star Portfolio Manager? 7. How does the tool account for differences in weather? 8. How does the tool calculate source energy? 9. Can this tool be used for LEED-EB?	1. What is NABERS? 2. How does NABERS relate to other environmental ratings? 3. Who manages NABERS? 4. Who can use NABERS? 5. What building types does NABERS apply to? 6. What does NABERS do? 7. Why use NABERS? 8. What does NABERS measure?

Other Links for Benchmarking Tool

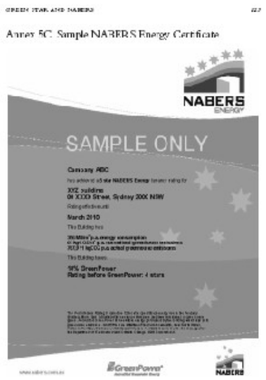
1. Australian Building Greenhouse Rating (ABGR)-NSW Department of Energy and Utilities and Sustainability (DEUS), Australia.
2. Online Benchmarking of Energy Consumption-EMSD, Hong Kong.
3. CALARCH- LBNL, United States.
4. Energy Concept Adviser-IEA, Europe
5. Lab 21- EPA and DOE, United States.
6. On-line energy benchmarking (Danish)- Danish Electricity Saving Trust (Elsparefonden), Denmark.
7. Sorted benchmarking links

3. Certificates

Energy Smart, Singapore : Sample Certificates



NABERS, Australia :



I. Comparison of International Energy Research Institutes

Table of Contents

I. Comparison of International Energy Research Institutes

1. Energy Sustainability Unit, Singapore

1.1. Aim / Vision:

"To advance energy sustainable development in Singapore and the tropics by establishing a knowledge base for fostering healthy, productive and sustainable environmental practices and research".

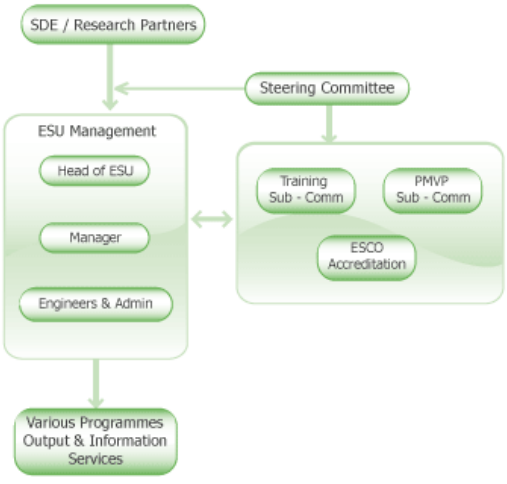
1.2. Partners & Stakeholder:

ESU was established in August 2004 at the School of Design and Environment, NUS through the support of the Economic and Development Board (EDB), the National Environment Agency (NEA) and the Energy Market Authority (EMA). It is a Partner of the Economic Development Board (EDB) Locally-based Enterprise Advancement Program (LEAP) and receives a Partnership grant of $400,000 over a period of 2 years to undertake 4 programmes sponsor by EDB.

1.3. Structure & Governance:

The overall structure of the Energy Sustainability Unit (ESU) is shown as follows. The Unit is jointly supported by the School of Design and Environment, NUS as well as the various Research Partners. The Unit has a Steering Committee to provide visions, direction and guidance to ensure the success of the various programmes under the Unit. The Unit is managed by Head of ESU, with the Manager overseeing the various programmes. To ensure the viability of programmes in the industry, Technical sub-committees are formed, comprising mainly of industry people from the various building sectors to provide valuable feedback and comments to the Unit.

Legend
EDB : Economic Development Board
LEAP : Locally based Enterprise Advancement Program
NEA : National Environment Agency
NUS : National University of Singapore
ESCO :Energy Service Company

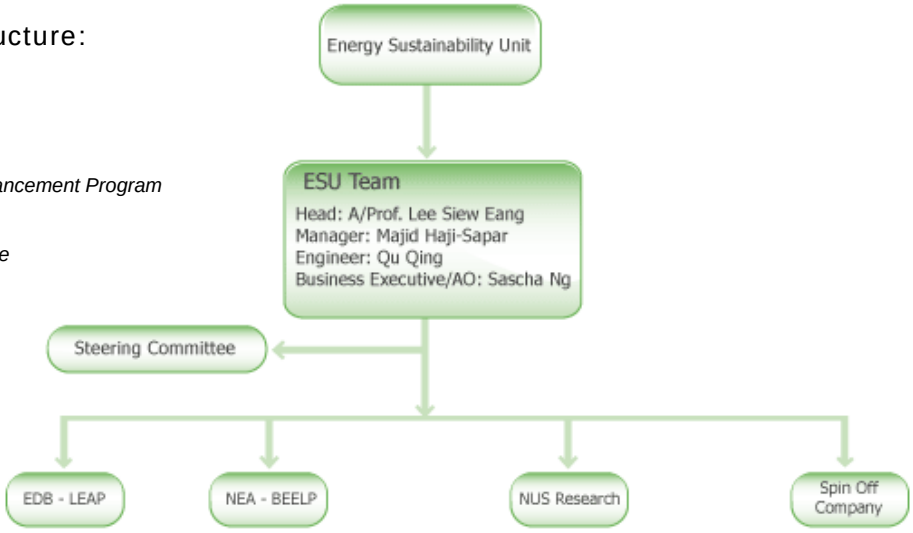


Steering Committee : Total 12 Members		
Chairman	*Building*	*Finance*
Industrial	*Statutory Board*	*Tertiary*

I. Comparison of International Energy Research Institutes

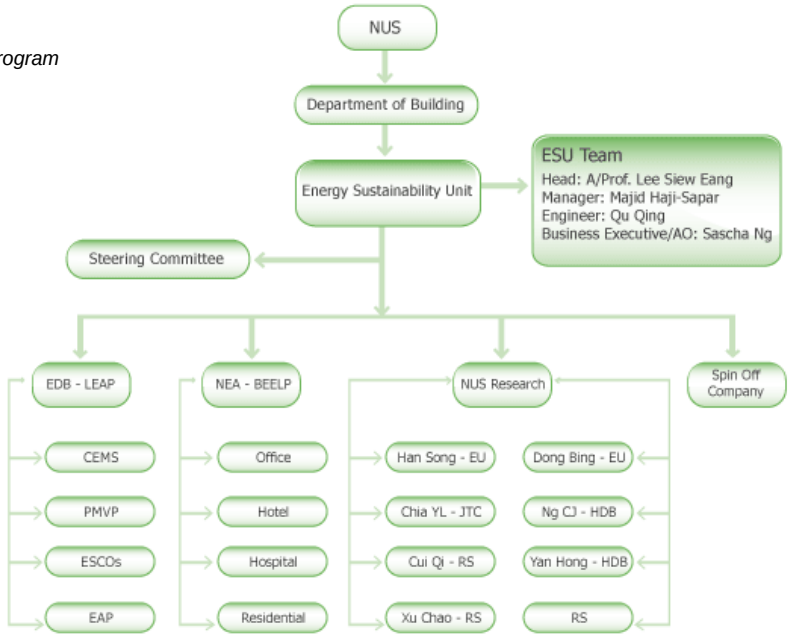
1.4. Organization Structure:

Legend
EDB : Economic Development Board
LEAP : Locally based Enterprise Advancement Program
NEA : National Environment Agency
NUS : National University of Singapore



1.5. Activities & Function:

Legend
EDB : Economic Development Board
LEAP : Locally based Enterprise Advancement Program
NEA : National Environment Agency
NUS : National University of Singapore
ESCO :Energy Service Company



EDB-LEAP Program
The program also oversees the following:

a. Establishing a Training Curriculum and a National Certification System for energy engineers and managers
b. Establishing a measurement and verification protocol on energy utilization for use by ESCOs in Singapore
c. Developing and implement a National Accreditation System of Energy Services Companies (ESCOs)
d. Organizing events to educate professionals, industries and financial institutions

I. Comparison of International Energy Research Institutes

2. Smart Energy Design Assistance Center, Illinois

2.1. Aim / Vision:

The Smart Energy Design Assistance Center (SEDAC) provides advice and analysis enabling private and public facilities in the State of Illinois to increase their economic viability through the efficient use of energy resources.

2.2. Partners & Stakeholder:

SEDAC is sponsored by the Illinois Department of Commerce and Economic Opportunity in partnership with Com Ed and Ameren Illinois Utilities and provides valuable services at *no cost* to for-profit businesses and public facilities. SEDAC is managed by the School of Architecture at the University of Illinois at Urbana-Champaign and the 360 Energy Group.

2.3. Organization Structure :

Managing Director	**Technical Director**
Design Assistance Specialists	**Program Specialists**
Students	**Course Presenters**

2.4. Activities and function:

a. Energy efficiency analysis and technical design assistance services for qualified clients who are planning energy upgrades. These analysis identify opportunities for saving energy and money in both existing buildings and new designs.
b. Feasibility studies designed to identify economic incentives.
c. Introduction to our Pre Qualified Service Energy Provider Network.
d. Identifying economic opportunities with the EP Act 2005 tax incentive program and the Illinois Energy Efficiency Portfolio Standard (EEPS).
e. Education and Training.
f. Goals

1.**Reduce the cost of doing business** for Illinois entities through energy efficiency design assistance projects and through the market transformation which will result from publicity of those projects.

2. Demonstrate to businesses and public entities the **cost-effectiveness of energy efficiency strategies** as a response to higher energy prices.

3. **Support job creation and retention in Illinois** by reducing operating costs, and providing a variety of business opportunities for architects, engineers and other building professionals by offering the chance to learn and practice innovative new efficient building design and construction techniques.

4. **Support electric reliability** in the state by promoting energy efficient building practices that release system capacity and have a reduced peak demand profile.

5. **Reduce pollution** by minimizing wasted energy, and thereby demonstrating that economic growth and environmental protection go hand in hand.

3. New Building Design Institute, US

3.1. Aim / Vision:

New Buildings Institute (NBI) is a nonprofit organization working collaboratively with commercial building market players—governments, utilities, energy efficiency advocates and building professionals— to improve the energy performance of commercial buildings & remove barriers including promoting advanced design practices, improved technologies, public policies and programs that improve energy efficiency.

3.2. Partners & Stakeholders:

Among its founders and project partners are the Energy Foundation, U.S. Green Building Council, American Institute of Architects, U.S. Department of Energy, Environmental Protection Agency, and leading electric utilities and public benefits administrators. Natural Resources Defense Council, American Council for an Energy-Efficient Economy, National Grid, Southern California Edison, the U.S. Green Building Council, and the California Energy Commission are some of the organizations represented on our Board.

3.3. Organization Structure:

Senior Program Manager, Senior Project Manager, Project Analyst, Senior Project Manager, Senior Consultant, Project Associate, Technical Director, Communications Manager, Operations Director, Lighting Manager, Project Manager, Communications Specialist, Contracts Manager, Executive Director, Program Director, Communications Director, Project Analyst, Senior Engineer, Accountant, Project Analyst, Project Analyst, Senior Analyst ,Project Manager.

3.4. Activities & Function:

Benchmarking
Evidence based Design & Operations Research Program
Evaluating Post Occupancy Program
Advanced Buildings
- Core Performance Guide
- Advanced lighting guidelines & Design tools
- Day lighting Pattern Guide
- Day lighting Guide for office interiors
- Mechanical Systems

4. Belgian Building Research Institute, Belgium

4.1. Aim / Vision:

The BBRI has following missions: to perform scientific and technical research for the benefit of its members, to supply technical information, assistance and consultancy to its members, to contribute in general to innovation and development in the construction sector in particular by performing contract research upon request of the industry and the authorities.

4.2. Partners & Stakeholder:

The Belgian Building Research Institute is a private research Institute founded in 1960 under impulse of the National Federation of Belgian Building Contractors in application of the ''De Groote '' Decreelaw of 1947.

4.3. Structure & Governance:

The activities of the BBRI are oriented directly by fifteen Technical Committees. Eleven of them are the direct representation of a branch of the construction industry (painters, joiners, heating equipment installers, etc.) and are composed essentially of contractors. The other Committees focus on subjects of interest to several branches, such as company management or acoustics. These are also composed of professionals active in construction.

4.4. Organization Structure:

To fulfill its mission BBRI pools on the expertise of some 200 highly skilled and motivated staff members with widely varying education, allowing as such setting up multidisciplinary teams as required by the problems to be dealt with.

4.5. Activities & Function:

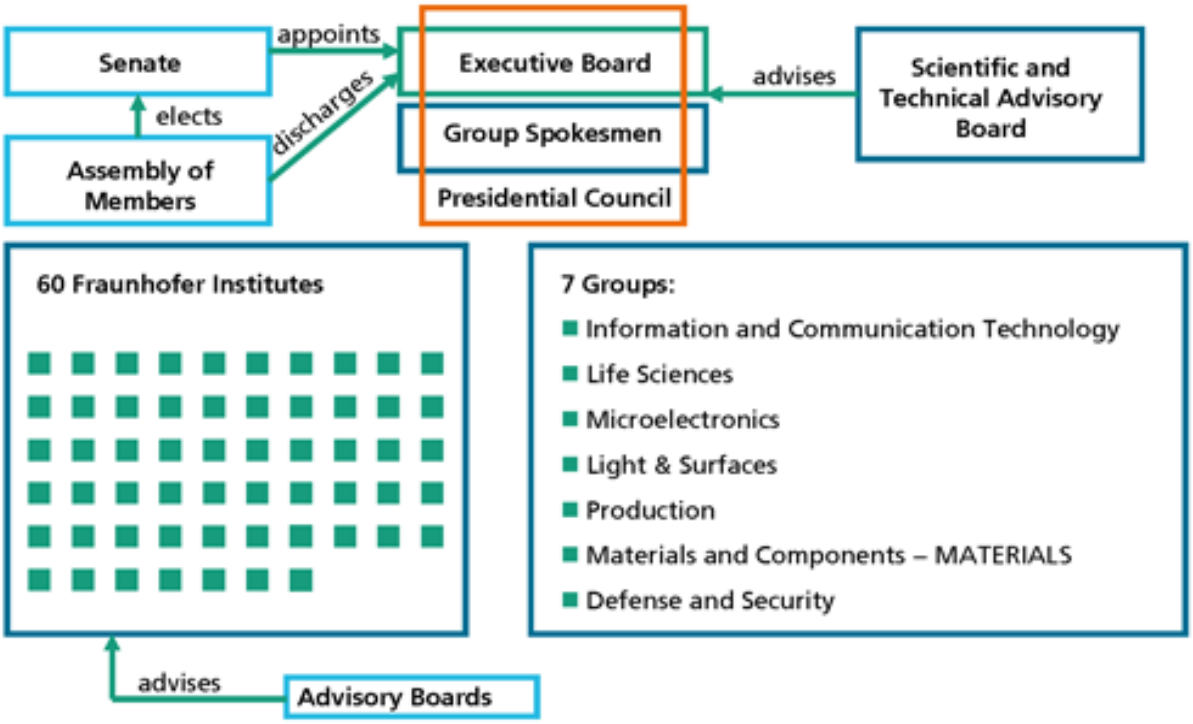
a. Technical Assistance
b. Building Products
c. Innovation Support
d. Planning
e. Technical Approval
f. Virtual Construction
g. Standardization / Regulation
h. CE Marking
i. Patent Units

5. Fraunhofer Research Institute, Europe

5.1. Aim / Vision

Fraunhofer is Europe's largest application-oriented research organization. The activities of the Fraunhofer IAO focus on investigation of current topics in the field of technology management. A holistic approach is applied to the study of commercial success, employees' interests and social consequences.

5.2. Partners & Stakeholders

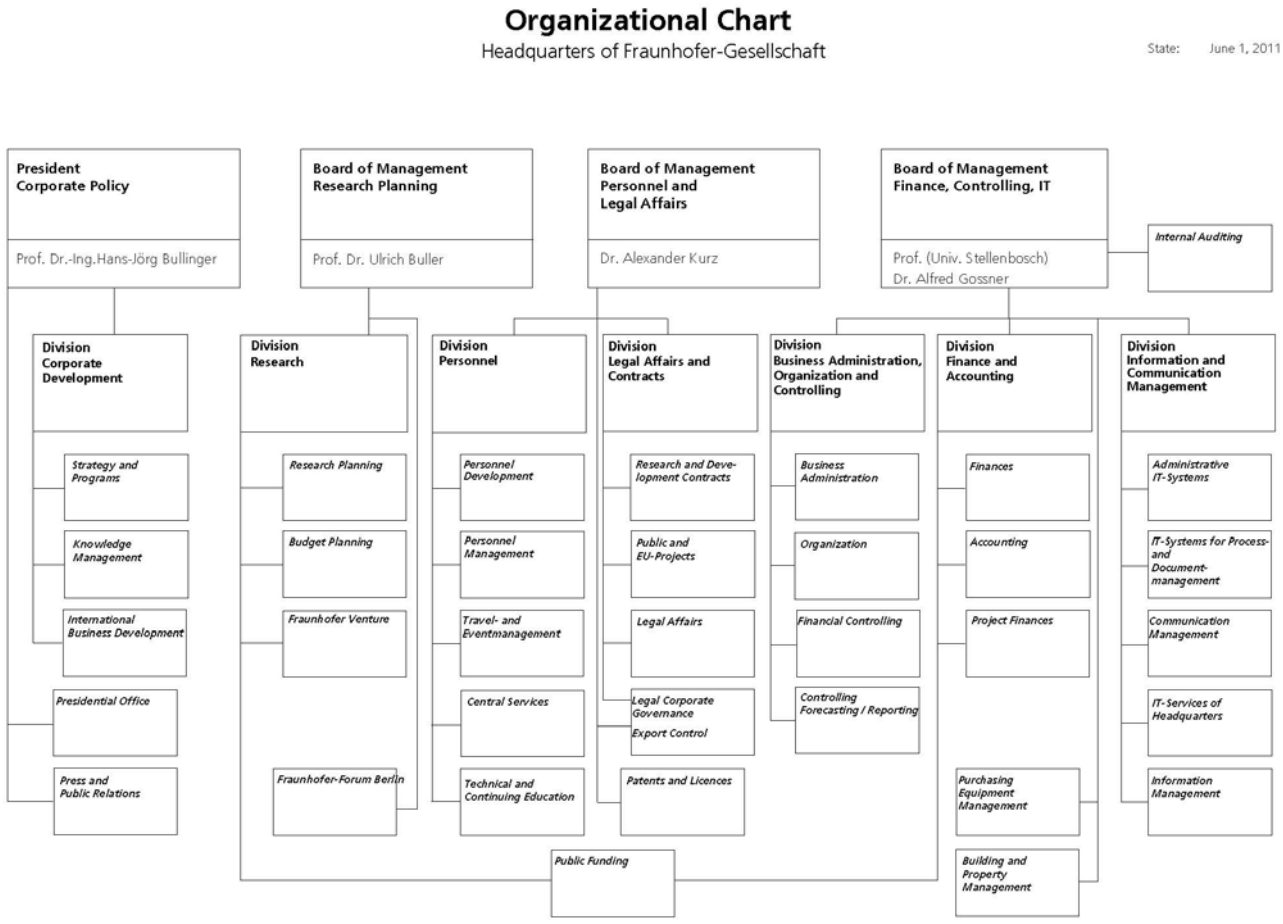


5.3. Structure & Governance

a. Fraunhofer-Gesellschaft, the largest organization for applied research in Europe.
b. More than 80 research units, including 60 Fraunhofer Institutes, at different locations in Germany.
c. The majority of more than 18, 000 staff are qualified scientists and engineers €1.66 billion annual research budget totaling. Of this sum, €1.40 billion is generated through contract research. More than 70 percent of the research revenue is derived from contracts with industry and from publicly financed research projects. Almost 30 percent is contributed by the German federal and Länder governments in the form of institutional funding
d. Research centers and representative offices in Europe, USA, Asia and in the Middle East

I. Comparison of International Energy Research Institutes

5.4. Organizational Structure



6. Frequently Asked Questions

1. Which entities are eligible for Building Performance Institute Services?
2. What services does the BPI program provide?
3. Is there a cost for the program/services?
4. What has the BPI program accomplished?
5. Will I be able to afford BPI recommendations?
6. Does BPI provide funding for energy efficiency projects?
7. How long will it take to get some recommendations?
8. How do I apply for BPI services under the BPI program?
9. What does a BPI energy audit look like?
10. How can Energy Service Providers Participate in BPI?
11. How can Architectural/Engineering Firms Participate in BPI?

7. References

1. Energy Sustainability Unit :*http://www.esu.com.sg/*
2. Smart Energy Design Assistance :*http://smartenergy.arch.uiuc.edu/index.html*
3. New Building Institute :*http://www.newbuildings.org/advanced-energy-codes*
4. Belgian Building Research Institute :*http://www.bbri.be/homepage/index.cfm?cat=bbri&sub=presentation*
5. Fraunhofer Research Institute:*http://www.iao.fraunhofer.de/lang-en/jobs-und-karriere/hiwi-stellen.html*

8. Other International Energy Related Agencies and Organizations

1. American Council for an Energy Efficient Economy :*http://www.aceee.org*
2. ASEAN Center for Energy :*http://www.aseanenergy.org/*
3. Asia Pacific Energy Research Center :*http://www.ieej.or.jp/aperc/*
4. Building Research Establishment, UK :*http://www.bre.co.uk/*
5. Carbon Trust, UK :*http://www.carbontrust.co.uk/Pages/Default.aspx*
6. Energy Conservation Center , Japan :*http://www.asiaeec-col.eccj.or.jp/index.html*
7. Energy Conservation In Buildings And Community System, IEA :*http://www.ecbcs.org/*
8. Energy Star, USA :*http://www.energystar.gov/*
9. European Commission-Energy :*http://ec.europa.eu/*
10. European Council for Energy Efficiency Economy :*http://www.eceee.org/*
11. International Energy Agency :*http://www.iea.org/*
12. International Performance Measurement and Verification Protocol :*http://www.evo-world.org/*
13. International Network for Information on Ventilation and Energy Performance :*http://www.inive.org/*
14. Malaysia Energy Center :*http://www.ptm.org.my/*
15. National & Kapodistrian University of Athens , Greece :*http://en.uoa.gr/*
16. Oak Ridge National Laboratory :*http://www.ornl.gov/*
17. UK National Energy Foundation :*http://www.natenergy.org.uk/*
18. U.S. Environmental Protection Agency :*http://www.epa.gov/*
19. U.S Department of Energy :*http://www.energy.gov/*
20. U.S Lawrence Berkeley National Laboratory :*http://www.lbl.gov/*
21. VTT Technical Research Center of Finland :*http://www.vtt.fi/*
22. Building and Construction Authority: *http://www.bca.gov.sg/*
23. Center for Total Building Performance, National University of Singapore: *http://www.ctbp.bdg.nus.edu.sg/*
24. Department of Building, National University of Singapore: *http://www.bdg.nus.edu.sg/*
25. Economic Development Board: *http://www.edb.gov.sg/edb/sg/en_uk/index.html*
26. Energy Market Authority: *http://www.ema.gov.sg/*
27. Housing Development Board :*http://www.hdb.gov.sg/*
28. Jurong Town Corporation: *http://www.jtc.gov.sg/Pages/index.aspx*
29. National Environment Agency: *http://app2.nea.gov.sg/index.aspx*
30. National University of Singapore: *http://www.nus.edu/*

J. Database management comparison chart for various countries

Country	Austria	Belgium (Flanders)	Bulgaria	Cyprus	Czech Republic	Denmark	Estonia	Finland	France	Germany	Greece	Hungary	Ireland	Italy	Latvia	Lithuania	Luxembourg	Malta	Netherlands	Poland	Portugal	Romania	Slovak Republic	Slovenia	Spain	Sweden	UK (England&Wales)	Croatia	Norway	Switzerland
1. What method do you use for energy performance certification?																														
Calculated energy performance for all building types and ages	X		X	X	-	X					X			X	X	X		-	X	X	X	X	X		-			X	X	X
Measured energy performance for all building types and ages			X		-										X			-					X		-	X				X
Method depends on the building type and/or age		X			-		X	X	X	X		X	X				X	-						X	-		X			
2. How is the database for collecting building energy performance certification data organised?																														
One nation wide database			B	C		C	B		B		C	C	B		B	C			C		C	C		B		B	B	C	C	
Regional databases	C	B												C																
Multiple databases, one for each accepted certification tool																														
Multiple databases, one for each certification method (calculated/measured)																														
No collection in database								B									B			C			B							
Other	C									B				C															M	B
3. Who is responsible for the database in your country?																														
Central, official authority			B	C		C	B		B		C	C	B	C	B	C			C		C		B	B		B	B	C	C	
Regional, official authority	C	B												C																
Private company/companies	C																							B						M
Other										B												C								C
4. How are data collected in the database?																														
Automatically reported from the accredited certification tools		B		C		C							B						C		C						B			
Reported directly from the consultant/expert/assessor			B				B		B		C	C		C	B	C			C			C	B	B		B		C		M
Central secretariat transferring data from the certificates to the database																														
Other	C									B																			C	

J. Database management comparison chart for various countries

Country	Austria	Belgium (Flanders)	Bulgaria	Cyprus	Czech Republic	Denmark	Estonia	Finland	France	Germany	Greece	Hungary	Ireland	Italy	Latvia	Lithuania	Luxembourg	Malta	Netherlands	Poland	Portugal	Romania	Slovak Republic	Slovenia	Spain	Sweden	UK (England&Wales)	Croatia	Norway	Switzerland
5. If you collect data in a database, which data do you collect?																														
All information collected during inspection (U-values, areas, efficiencies, etc), energy label		B				C					C	C	B		B	C					C	C	B	B		B	B	C		
Only energy performance, label and recommendations			C						B					C																
Energy performance	C									B																				M
Energy label												C							C											M
Only building id																														
Other	C						B			B			C			C			C										B	M
6. Quality check on data (tick all that apply)																														
Probability check on entry, e.g. acceptable value range for different parameters		C								B			C			C								B			B		C	M
Field compliance check, e.g. no text in numerical fields		C								B						C			C					B		B	B	C	B	M
Check that all requested data is available before entering the database		C	C				B		B	B			C			C			C					B		B	B		C	
All data from a certificate is rejected if crucial data is missing			C										B			C			C							B	B		C	
Generation of statistical information and cleaning of data and identifica-tion of out-of-range data after input																														
Manual cleaning of data and identification of out-of-range data after input										C														C			C			C
Other										C														C		C	C		C	C
7. Have you tried to generate a full certificate from information in the database?																														
Yes, with success													B								C					B		C	C	M
Yes, but with limited success			C			C																		B						
No	C			C			B		B	B	C	C		C	B	C			C			C					B			
8. Have you tried to use information in the database for other purposes, e.g. calculation of national saving potentials or market penetration?																														
No		B		C			B		B	B	C	C	B		B	C						C		B			B	C	B	
Yes	C		C			C								C					C		C					B				M

the buildings energy performance: C = calculated energy performance; M = measured energy performance;B = both calculated and measured energy performance under certain circumstances.

Source : Energy Performance of Building Directive, Europe

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