SAARC Energy Centre, Islamabad

Pakistan

THE REPORT

Webinar On "Designing Efficient Buildings in SAARC Region"

23rd June, 2020

Organized by

SAARC Energy Centre Islamabad

June 23, 2020

SAARC Energy Centre
697, Street 43, Sector E-11/4 (NPF),
Islamabad, Pakistan
www.saarcenergy.org

Introduction

1. SAARC Energy Centre, (SEC) under its approved program for the year 2020 successfully conducted a Webinar on "Designing Energy Efficient Buildings in SAARC Region" on Tuesday June 23, 2020. Webinar Agenda is available at Annexure I.

2. The Webinar highlighted the most pressing topics of Energy Efficient Buildings, with experts leading the discussions and presentations on proven best practices, cost-effective strategies, and innovative new ways to approach sustainability and energy performance. The webinar featured brief talks and presentations from field experts, covering mainly the following five thematic streams:

1. Energy usages and wastages in overall building sector
2. Importance of energy efficient buildings for health, comfort and air quality
3. Heating, cooling, lighting and ventilation in energy efficient buildings
4. Energy standards for buildings and their importance
5. Energy audits of buildings

3. The experts shared latest technological developments related to the above thematic areas. They also shared policy, regulatory and financial insights in this regard, using case studies from SAARC Member States and other countries worldwide.

Participation

4. The Webinar was registered by 200 people and attendees included delegates from Member States, Representatives of Regional / International organizations, Academia and private sector. Experts from Shakti Foundation India, Centre for Building and Industrial Energy Audits (CIBEA) Pakistan, National University of Science & Technology (NUST) Pakistan and

China Academy of Building Research joined the webinar as speakers. The list of participants is available at Annexure-II.

Opening

5. Due to the COVID-19 situation and lockdown in Pakistan, SEC officials attended the webinar from their homes. Dr Tanvir Ahmad (Program Leader – Technology Transfer), opened the webinar, as the program coordinator. He briefly informed the participants about the importance of this webinar. He also introduced the speakers and informed the participants about the Q&A session and procedure.

Technical Proceedings

6. The webinar hosted talks and presentations from four subject experts. The expert list is available at Annexure-III. The presentations delivered during the webinar are available at Annexure-IV. These presentations are also available at SEC's website http//: www.saarcenergy.org. A brief information on the content of the delivered presentations is as follows:

Presentation 1 – Green building in a post Covid-19 India

Expert: Mr Shubhashis Dey, Associate Director, Energy Efficiency Program in Shakti Sustainable Energy Foundation India

7. Mr. Shubhashis Dey started his presentation with a brief introduction of his organization Shakti Sustainable Energy Foundation India and the overall impact they have created in the energy sector in the SAARC region. Given the ongoing COVID-19 situation around the globe, he selected a very relevant and important topic relating the spread of pandemic to housing and how energy efficient buildings can reduce the spread of this pandemic.

8. He informed the participants that in majority of Indian cities, which are worst affected by the current pandemic; the urban slums, unauthorized colonies and densely populated areas with poor building designs became the hot bed for Covid-19 infection. Unavailability of energy efficient, healthy and affordable houses in cities was one of the principle reasons for reverse migration of migrant workers in India. The spread of Covid-19 infection in India indicates that during a pandemic where self-isolation is required, the design and quality of a home and neighborhood is a key contributor to the health and wellbeing of the people who live there.

9. He also presented some future energy efficient technologies; especially for cooling and the impact of architecture. He concluded his presentation by giving examples of energy efficiency in the architecture of historical buildings and modern urban societies.

Presentation 2 – Energy Wastage and Recovery Options in Buildings

Expert: Dr Mohammad Adil, Deputy Director, Center for Industrial and Building Energy Audits, UET Peshawar Pakistan

10. Dr Adil presented different types of energy wastages in buildings and their recovery options. He showed that more than 40% of the energy is consumed in the residential sectors. He informed the participants about the blower-door test for assessing that how much energy is wasted in buildings.

11. The blower-door test in residential buildings shows that reduction in cooling load due to infiltration control is around 25% of the total cooling load. The reduction in heating load is around 21% of total heating load. The blower-door test in commercial buildings confirm that the reduction in cooling load due to infiltration control is 12% of the total cooling load. The reduction in heating load is around 32% of total heating load.

12. He concluded that BIM + blower-door audit is a possible way or reducing 12 – 32% of energy wastage in heating and cooling, which is equivalent to 7 – 17% reduction of the total energy demand in all sectors combine in Pakistan.

Presentation 3 – Development of Green Building in China and Main Technical Standards

Expert: Dr Guozhu Li, Deputy Director, China Academy of Building Research China

13. Dr Li presented different technical standards for development of green buildings in China. He provided a brief introduction of China Academy of Building Research (CABR). He presented the Chinese philosophy that developing green building is one of the ways to form a new pattern of the harmony between human and nature.

14. Dr Li also showed the Chinese policy and standard system and introduced the latest standard. The latest standard demands to follow the new technologies and concepts in building industry. He concluded that the five performance parameters set in the latest standard are safety and durability, health and comfort, occupancy convenience, resource saving and environment livability. He also concluded that green buildings can significantly contribute to the fight against COVID-19.

Presentation 4 – Promoting Energy Efficient Green Buildings in SAARC Region using EDGE Green Building Rating System

Expert: Dr Muhammad Bilal Sajid, Assistant Professor, US Pakistan Center for Advanced Studies in Energy (USPCAS-E) NUST Pakistan

15. Dr Bilal Sajid presented the EDGE rating system and explained the energy efficiency features through case studies. EDGE is a resource efficiency system for new and existing buildings in emerging markets. It is already available in more than 160 countries. The EDGE certified buildings have reported up to 20% reduction in energy consumption.

16. He also explained the EDGE certification cycle moving from design to operation phase through the construction phase. EDGE has been used in home, retail, hotels, office,

educational and hospital buildings. It can be used in new construction and the existing buildings can be retrofitted to gain benefits of the EDGE system.

17. He concluded his presentation by explaining different case studies from around the globe showing the energy efficiency measures taken. He also disseminated the detailed certification process and available helping material in this regard.

Questions & Answers

1. **What are the challenges and opportunities of energy efficient retrofits for existing building?**

   Mr. Shubhashis Dey: The only challenge I can see is the initial cost. Beyond that energy efficiency is an asset, already realized by many commercial building's owners in India. Local industry shall be promoted to reduce the initial cost of the retrofits. Replacing inefficient appliances with efficient ones have yielded in significant savings in existing buildings.

2. **Affordability has been the major factor due to which the spread of energy efficient design or technology has been slow as well as uneven. How is that factor being tackled??**

   Mr. Shubhashis Dey: A building with all the basic benefits of green and energy efficient buildings, the cost escalation is either zero or one percent, if these are included from the initial design phase of the building. For existing buildings, the cost escalation was 5% to 10%.

3. **With Increasing Humidity and Temperatures What are the methods for Sustainable Cooling and there funding opportunities for efficient cooling?**

   Mr. Shubhashis Dey: There are many funding opportunities available by donor agencies such as the UN bodies, USAID, GIZ and relevant national agencies.

4. **What are some recommendations in the Indian cooling action plan?**

   Mr. Shubhashis Dey: The major recommendations are that we need to provide thermal comfort to all by 2037 to every household. This may include some kind of cooling and heating using space cooling and traditional cooling. Another recommendation is to design and develop energy efficient and affordable appliances.

5. **Are there any studies to use the traditional passive cooling techniques (used in historical buildings) that can be adopted in new buildings?**

   Mr. Shubhashis Dey: Organizations like Indian Green Building Council, Pakistan Green Building Council and The Energy Research Institute India (TERI) have relevant publications and studies detailing the passive cooling techniques that can be adopted in new buildings.

6. **What software you would suggest for designing efficient green buildings? What is the recommended software in conducting energy efficiency studies for facilities?**

   Dr. Adil: There are many software available for this purpose. However, not all the software gives you the final results or recommendations. Some interpolation is always required for efficiently using a software. For example, the software used by in the US for building energy models may not be applicable in SAARC region due to climatic and geographical variations.

7. **Is there any material specification or traditional material with value added chemical/alteration can be used for energy efficient building?**

   ***Dr. Adil*:** Some traditional materials like mud can be used for energy efficiency. For example, the traditional mud is modified using the latest technologies, which gives very unique energy efficiency results. There are other polymers and materials as well, which can be used for energy efficiency in buildings.

8. **How can the monthly cost of Energy consumption be reduced without reducing comfort level?**

   Dr. Adil: These two are very much corelated. If building information models are used specific to a building, then the comfort level can be maintained. One set of recommendations may not be true for another building. Hence, there is no single answer to this question but it will depend from building to building.

9. **Are there any energy efficiency financing schemes available in Pakistan?**

   Dr Adil: NEECA is the custodian organization for energy efficiency in Pakistan. They are planning to introduce such financing schemes in Pakistan this year (2020). Other sister organizations are also working keenly in collaboration with NEECA for introducing such schemes.

10. **What is the duration and cost of Blower-door equipment test?**

    Dr. Adil: The test duration for a single room is around one hour, when the equipment is present on site. For the whole building with a centralized system, the whole facility has to be checked for leakages and openings, which may take one extra hour. For residential buildings on average the duration is one to two hours, while for commercial buildings it is three to five hours. The cost by CIBEA is fixed, which is almost 80 USD, for a larger capacity the cost increases accordingly as per the size and income level of the auditee.

11. **How common is usage of BLDC fans in Pakistan? BLDC ceiling fans consume almost 50% electricity (30-35W) in comparison to regular fans (60-70W).**

Dr. Adil: The DC fans with solar panels are used quite frequently in Pakistan, which are used in combination with a solar panel. Hence, it does not provide any load on the grid as the system is centrally distributed. NEECA is working for developing standards for energy efficient fans.

12. **Do you think that working on the Behavior Change of the population can be also a good practice to bring in energy efficiency in our residential buildings or it's just the technical replacements which can play part in bringing efficiency?**

Dr. Adil: Human behavior cannot be neglected for developing and maintain a culture of energy efficiency. However, unlike the common perception, it does not play a huge role in energy efficiency, thanks to the thermostat and sensor technology. With the boom in automation industry, energy wastage due to human behavior specially at commercial levels has been reduced significantly.

13. **What political instruments are used by the Chinese government to promote Residential Green Buildings?**

Dr. Li: The government always supports green buildings throughout the country. The standards mentioned in this presentation prove this support. This support is with a top-down approach starting from the central government till the local representatives. Similarly, each region can have their own policy as per their needs for promoting green buildings.

14. **Are there any financial mechanisms to assist residents who may not be viable to adopt Green Building?**

Dr. Li: There are regional interventions to support such projects. This support is sometimes direct or at times in kind from the government or other agencies.

15. **Is any firm or organization is working on Green buildings in Pakistan?**

Dr. Bilal: NEECA and the Pakistan Green Building Council are mainly working on the green buildings in Pakistan. Similarly, other multi-lateral organizations such as UNIDO and USAID are also working actively for promoting green buildings in Pakistan.

16. **Is EDGE similar to Portfolio Manager (Energy Star)?**

***Dr. Bilal*:** In terms of ease of use, these are similar. However, EDGE covers mostly the design aspects as compared to the operational aspects.

17. **Does the level of support from the EDGE team depends upon the worth of the project?**

***Dr. Bilal*:** It is the same, no matter what is the worth of the project. Adding to this, if the project is registered with EDGE, then they provide the highest level of support.

Vote of Thanks and Closing of Webinar

Dr Tanvir Ahmad, Program Leader (Technology Transfer), SEC

16. Dr Tanvir Ahmad, informed all the participants that the presentations will be available on SAARC Energy Centre's website (www.saarcenergy.org). He requested the participants to submit suggestions and comments to SEC for any further improvement of these webinars, plus they may suggest and submit any topics of their interest for arranging future webinars. The webinar was closed with special thanks to the speakers and everyone attending the webinar.

Annexures

Annexure-I

Webinar Agenda

"Designing Energy Efficient Buildings in SAARC Region"
Tuesday June 23, 2020

Time Slot	Contents
1100 – 1110	**Introduction**
1110 – 1145	**Green building in a post Covid-19 India** Mr Shubhashis Dey Associate Director, Energy Efficiency Program in Shakti Sustainable Energy Foundation India
1145 – 1150	Q & A
1150 – 1225	**Energy Wastage and Recovery Options in Buildings** Dr Mohammad Adil Deputy Director, Center for Industrial and Building Energy Audits, UET Peshawar Pakistan
1225 – 1230	Q & A
1230 – 1305	**Development of Green Building in China and Main Technical Standards** Dr Guozhu Li Deputy Director, China Academy of Building Research China
1305 – 1310	Q & A
1310 – 1345	**Promoting Energy Efficient Green Buildings in SAARC Region using EDGE Green Building Rating System** Dr Muhammad Bilal Sajid Assistant Professor, US Pakistan Center for Advanced Studies in Energy (USPCAS-E) NUST Pakistan
1345 – 1350	Q & A
1350 – 1400	Closing of Webinar

Information for the participants:

1. All times mentioned in agenda are according to Pakistan Standard Time (PKT). The participants from other Member States may attend Webinar by following their own national time. The time conversion for all Member States is given below for reference:

Country	Afghanistan	Bangladesh	Bhutan	India	Maldives	Nepal	Sri Lanka
Local time	(PKT-00:30)	(PKT+01:00)	(PKT+01:00)	(PKT+00:30)	PKT	(PKT+00:45)	(PKT+00:30)

2. The participants can ask questions to presenters by typing questions or clicking to the raised hand option into the Attendees pane of the main window of GotoWebinar software. You may send in your questions at any time during the presentations; we will collect these and address them during the Q&A session at the end of each presentation

List of Participants

Sr. No.	First Name	Last Name	Email
1	Mohammad	Irfan	mairfan@uetpeshawar.edu.pk
2	Mehnaz	Khurshid	cs@saarcenergy.org
3	Matou	Chingsubam	chinsubam.matouleibi@gmail.com
4	Mohsin	Ismail	mohsin.ismail@ntdc.com.pk
5	Masood	Amanzai	masood.amanzai@gmail.com
6	Madiha	Qayyum	engrmadiha15@gmail.com
7	Matou	Chingsubam	matouleibi@cbalance.in
8	Naeem	Malik	naeemmalik@saarcenergy.org
9	Chetana	Airani	chetana.airani3@gmail.com
10	Bhaskar	Natarajan	natbhaskar@gmail.com
11	Syed Tanveer Ahmed	Jafri	ceo@jpcl.com.pk
12	Muhammad Bilal	Sajid	mbilalsajid@gmail.com
13	Shubhashis	Dey	shubhashis@shaktifoundation.in
14	Mohammad	Adil	adil@uetpeshawar.edu.pk
15	MUHAMMAD ALI	NAWAZ	ALII.NAWAZ92@GMAIL.COM
16	Muhammad	Ashraf	ashraf@nppmcl.com
17	Mohiuddin	Ahmed	ronju.ahmed@gmail.com
18	Amanda	Santiago	amanda.pg190097@cept.ac.in
19	Chandra	Kumar	uckumar2@gmail.com
20	Divya	Chaudhari	divyachaudhari1996@gmail.com
21	MATOULEIBI DEVI	Chingsubam	chingsubam.matouleibi@gmail.com
22	FAHAD	KHAN	engrfahad3@gmail.com
23	Shoaib	Ahmad	ddcoord@saarcenergy.org
24	Rajneesh	Sareen	rajneesh.sareen@cseindia.org
25	Suresh	Kumar	engrkhatri79@gmail.com
26	Syed Zeeshan	Idrees	zeeshan.idrees@live.com
27	SALMAN BIN RAFIQ	CHAUDHRY	FORMANITE475@YAHOO.COM
28	Aparna	Kumar	aparnapm@gmail.com
29	Guozhu	Li	liguozhu50@163.com
30	Sumit	Kumar	sumit@chitkara.edu.in

Annexure-II

Sr. No.	First Name	Last Name	Email
31	Ahmad	Talha	rftt@saarcenergy.org
32	Aehtsham	Ul Haq	shami0001@outlook.com
33	Milabh	Shrestha	milabhivanovic@gmail.com
34	Muhammad Rashid	Raza	engr.rashid.89@gmail.com
35	Bushra	Rasheed	sardarbushra@yahoo.com
36	Affaq	Qamar	affaq.qamar@uetpeshawar.edu.pk
37	BILAL	SAIF	bsaif44@gmail.com
38	Kaleem	Khattak	kaleemktk2@yahoo.com
39	Shahzaib	Muhammad	zaibshah071@gmail.com
40	Rudhi	Pradhan	rudhi.pradhan@icf.com
41	Onais	Anwar	onais.anwar99@gmal.com
42	Yogesh	Kuwar	kuwar1991@gmail.com
43	Ameer Hamza	Durrani	4durrani@gmail.com
44	Abdul Masroor	Khan	engrmskhandaur@gmail.com
45	Uzair	Javed	uzairjaved07@gmail.com
46	Waleed	Ahmad	w_ahmad10@yahoo.com
47	Zain Ahmad	Khan	eengrzakhan@gmail.com
48	Arindam	Mondal	arindammondal89@gmail.com
49	SHAHID	ALI	engrshahid4103@gmail.com
50	Mushtaq	Muhammad	mushtaqmuhammad824@gmail.com
51	Munhammad Jamal	Butt	jamalbutt517@gmail.com
52	Shahid Ali	Khan	shahidalikhan414@gmail.com
53	KAMAL	GHOSH	kkgcme@gmail.com
54	Khalil	Ur Rehman	Khalil9t6@gmail.com
55	Inam	Ullah	inamuetian4@gmail.com
56	Sahid Ahamed Koya	P K	pk.sahidahamedkoya@gmail.com
57	Kamran	Khan	kamran.suit123@gmail.com
58	Umar	Aftab	umaraftab60@gmail.com
59	Mutahir	Abbas	Engr.mutahir@outlook.com
60	Kamran Ahmad	Malik	mkamran41@gmail.com
61	Ihsan	Marwat	rfee@saarcenergy.org

Sr. No.	First Name	Last Name	Email
62	Ammar	Hassan	coo@saarcenergy.org
63	Farman	Marwat	acctt.asstt@saarcenergy.org
64	SHIVAM	Kaushik	shivam02@infosys.com
65	Salah	Uddin	salahuddin443@yahoo.com
66	Aditya	Bhardwaj	aditya.bhardwaj@in.ey.com
67	Tanvir	Ahmad	pltt@saarcenergy.org
68	Abdul	Wahab	deo@saarcenergy.org
69	Inam	Ullah	engginam22@gmail.com
70	Kiran	Kumar	kv.kumar@unido.org
71	Asif	Ali	asif.ali6794@gmail.com
72	Hasan	Khan	hasan@cbalance.in
73	Pratibha	Manandhar	mdrpratibha@gmail.com
74	Muhammad Shoaib	Khan	muhammadshoaib5308@gmail.com
75	Danyal	Ahmed	danyalahmed115@gmail.com
76	MUHAMMAD	HADI	rm.hadi15@gmail.com
77	Disha	Sharma	dishas30@outlook.com
78	Fahad	Anees	fadiqureshi2@gmail.com
79	Ram Gopal	Lageju	lageju@gmail.com
80	Sulaiman	Khan	13pwciv3925@uetpeshawar.edu.pk
81	ijaz	ahmad	ahmadowwer@gmail.com
82	Afnan	Ahmad	afnan_19001642@utp.edu.my
83	Mudassir	Azam	mudassirzaman4100@gmail.com
84	Arfat	Ullah	arfatullah.uet@gmail.com
85	Rajeev	Yadav	rajyadav@deloitte.com
86	Abbas	Khan	abbas@cecos.edu.pk
87	Hooria	Ali	hooriaali25@gmail.com
88	Shafiqul	Alam	shafiqul.alam@giz.de
89	jawad	khan	jawaduet2012@gmail.com
90	Muhammad	Muneeb	munibahmad313@gmail.com
91	Ankit	Kamra	ankitkamra@gmail.com
92	Adam	Khan	adamkhan76333@gmail.com

Sr. No.	First Name	Last Name	Email
93	Haitham	Ashour	hashour85@gmail.com
94	Ramees	Kallarakkal	rameesraja.kn@gmail.com
95	Syed Fawad Hussain	Shah	fawad.mech@gmail.com
96	Arijit	Chattopadhyay	arijit.work.2012@gmail.com
97	Anusha	Mohan	anusha@cbalance.in
98	M. Faraz	Qasim	hi2faraz@gmail.com
99	Mohammad Abul Hasan	Khan	abulhasan.nep@gmail.com
100	Vinay	Varne	vinayy.varne@gmail.com
101	Rasika	Athawale	rathawale.consultant@raponline.org
102	Naveed	Ahmad	naveed.ahmad@insa-lyon.fr
103	Vinita	Rodrigues	vinita@cbalance.in
104	Yanshu	Agarwal	yanshu.pg191174@cept.ac.in
105	Anindya	Bhattacharya	anindya.b@thecelestialearth.org
106	Namratha	Sastry	namratha@cbalance.in
107	Dr. Muhammad Kashif	Shahzad	cto@pitc.com.pk
108	Sana	Wasi	sana85.wasi@gmail.com
109	Afaq	Tariq	afaqrj055@gmail.com
110	Arif	Ali	arifali8385@gmail.com
111	Saddam	Hussain	saddamahmad313@gmail.com
112	VIGNESH	ELANGO	er.vigneshe@gmail.com
113	Nitin	Saxena	saxenanitin85@gmail.com
114	Sammit	P	sammit15@gmail.com
115	Shoumik	Desai	shoumik.desai@cept.ac.in
116	Harish	Arora	HARISH.ARORA111@GMAIL.COM
117	Adarsha	Kapoor	bigfoot@creativefootprints.co.in
118	Mugdha	Malik	mugdha.malik@in.ey.com
119	Snowy	Christophel	snowy.pg190964@cept.ac.in
120	Shruti	Saraf	shruti@cbalance.in
121	Mahesh	Patankar	mahesh@mpensystems.com
122	Yash	Khanna	yash.k@thecelestialearth.org
123	Nikhil	Yaduvanshi	nikhil.yaduvanshi@yahoo.com

Annexure-II

Sr. No.	First Name	Last Name	Email
124	Nikhil	Yaduvanshi	nikhilsingh.pg180601@cept.ac.in
125	Garima	Kamra	garimakamra@gmail.com
126	Abdul	Basit	abdul.basit@uetpeshawar.edu.pk
127	Ritika	Jjain	ritika@shaktifoundation.in
128	Anurag	Bajpai	anurag@greentree.global
129	Atul	Krishna Kumar	atulkrishnakumar110@gmail.com
130	Tanvi	Bobhate	tanbobhate21@gmail.com
131	Raju	Sarepalli	jacobsarchitec@gmail.com
132	Mrinal	Aggarwal	mrinalanand24@gmail.com
133	Saumya	Sahni	saumyas760@gmail.com
134	Arvind	Puppala	as.nive2007@gmail.com
135	Anjan	Kumar Sinha	sinhaak_2157@yahoo.co.in
136	Benet	George	benet@bigetaenergy.com
137	Sirish Chandra	Posa	info@alfgreen.com
138	Ankit Kumar	Mishra	ankit.mishra38@gmail.com
139	Asad	Ullah	asadullah0315@gmail.com
140	SHANKHA	SUVRA	shankha.inc@gmail.com
141	Jaydeep	Bhadra	jdipbhadra@gmail.com
142	Mahabub	Sadiq	iamsadiq6670@gmail.com
143	IHTISHAM	UL HAQ	ihtishamulhaq.eep@uetpeshawar.edu.pk
144	Avinash	Ray	avinash@energizedsolutions.org
145	Dhruv	Malhotra	dm.dhruv24@gmail.com
146	Arghya	Majumder	arghyamajumder7@gmail.com
147	Steve	Pereira	steve.pereira9158@gmail.com
148	Syed Ghufran	Hashmi	syed.sh89@gmail.com
149	Pramod Kumar rambadan	Singh	singh_pramod82@yahoo.co.in
150	Partik	Kumar	pkiitjee@gmail.com
151	Mehran	Khan	mehrankhantest@gmail.com
152	Madiha	Qayyum	engrmadiha@15gmail.com
153	Soban	Shaukat	msobanshaukat@gmail.com

Sr. No.	First Name	Last Name	Email
154	zafarullah	khan	zafar.ullah@uetpeshawar.edu.pk
155	Abdullah	Kamal	kamaljani9974@gmail.com
156	Imran Ali	Shah	coaltechnology@gmail.com
157	Sajad	Ullah	sajad.ullah@yahoo.com
158	Muhammad Khayyam	Ilyas	khayyam.ilyas@gmail.com
159	Arjmand	Khaliq	arjmandkhaliq@gmail.com
160	Syed Faisal	Shah	S_syedfaisal@yahoo.com
161	Muhammad Rehan	Saeed	engrrehan066@gmail.com
162	Syed Md Sahriar	Abdullah	syed.sahriar@gmail.com
163	IHTISHAM	SHAH	ahtishamshah@pta.gov.pk
164	Zeeshan	Ali	zeeshan.ali8025@gmail.com
165	Inayat	Ullah	inayat.ullah@uetpeshawar.edu.pk
166	Zahoor	Ali	engrzahoorali2016@gmail.com
167	Shawkat	Ali	engrshaukatswati@gmail.com
168	Shakir	Ullah	engnr.shakir@gmail.com
169	Yasir	Rahman	engr.yasir804@gmail.com
170	Muhammad	Kamran	mkamranaltaf@gmail.com
171	Qaizar	Khan	qaizarkhan1@gmail.com
172	Naveed	Akhtar	naveed.akhtar@nbo.com.pk
173	Muhammad Hilal	Khan	muhammadhilal@yahoo.com
174	Muhammad	Zeeshan	Engrzeeshan110@yahoo.com
175	IRFAN	ULLAH	engr_irfanmarwat@yahoo.com
176	Aamir	Khan	aamir.khan@uetpeshawar.edu.pk
177	Danial	Javed	16pwciv4599@uetpeshawar.edu.pk
178	Engr. Umair	Iqbal	umair.iqbal482@gmail.com
179	Zahid	Ullah	engrzahidullah92@gmail.com
180	Maham	Murad	m.murad@uetpeshawar.edu.pk
181	Zain	Khalid	zaainkhalid@gmail.com
182	Kamran	Khan	kamran0841@gmail.com
183	Kashif	Ali	alikashif145@gmail.com
184	Sjafi Ullah	Baig Tariqi	shafiubt@yahoo.com

Annexure-II

Sr. No.	First Name	Last Name	Email
185	Ahmad	Nassar	ahmadnr1991@yahoo.com
186	Chu Donatus	IWEH	chu.iweh.stu@uenr.edu.gh
187	Muhammad	Nazeer	muhammadnaxeer@gmail.com
188	Shabir	Khan	shabiruet555@gmail.com
189	Iftikhar	Khan	iftikhargikian@gmail.com
190	Muhammad	Awais	awaiskhan640@gmail.com
191	Ayesha	Alam	ayesha.alam.ft@gmail.com
192	Ahsan	Zafar	ahsanuetp@hotmail.com
193	Prakash	Gyawali	gyawaliprakash01@gmail.com
194	Syed Khubaib	Ahmed	syedkhubaib1306@gmail.com
195	Muhammad	Aashir	aashirharoon@gmail.com
196	Akhwand Shujaan	Sarmad	shujaan.sarmad1@gmail.com
197	Masood	Khan	mkhan988@hotmail.com
198	Mohsin	Hamid	mohsinhamid66@gmail.com
199	Muhammad Shahzad	Siddique	differencer93@gmail.com
200	Muhammad Farooq	Siddique	farooqsiddique.mech@gmail.com

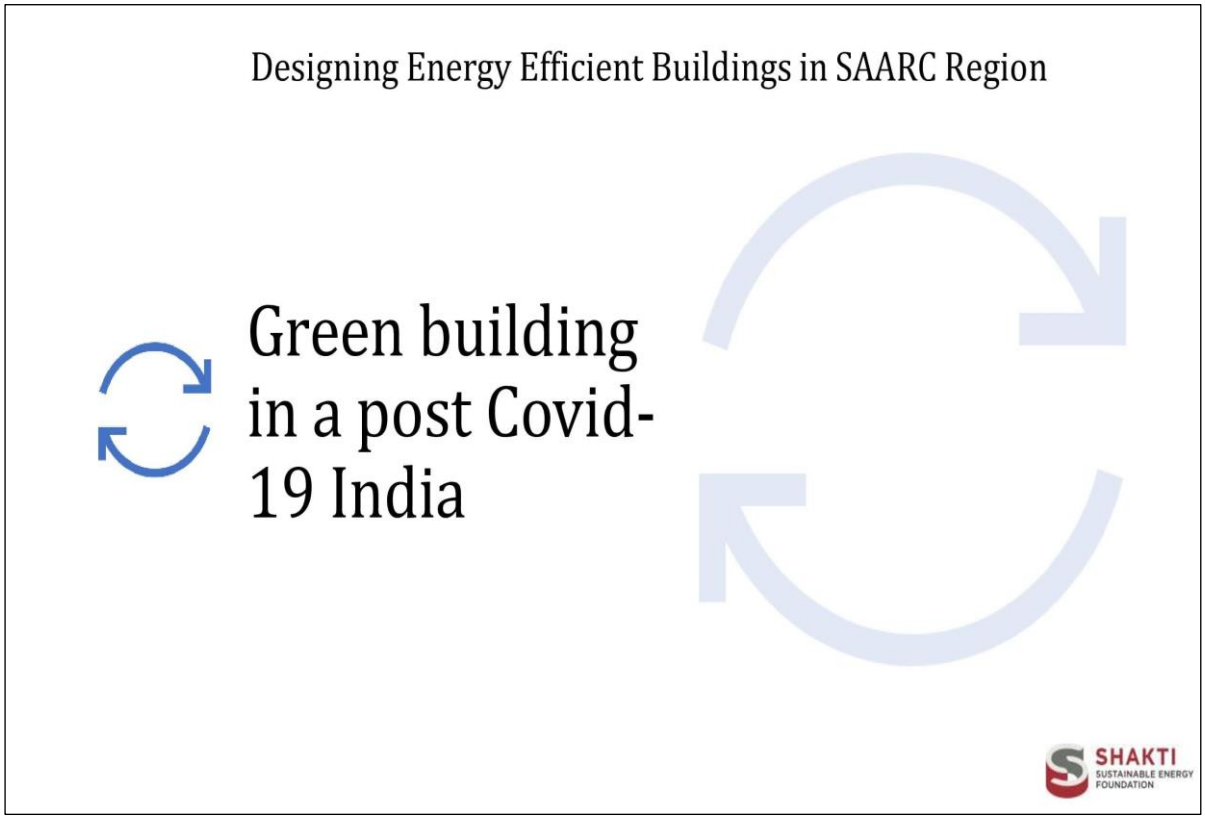
Annexure-III

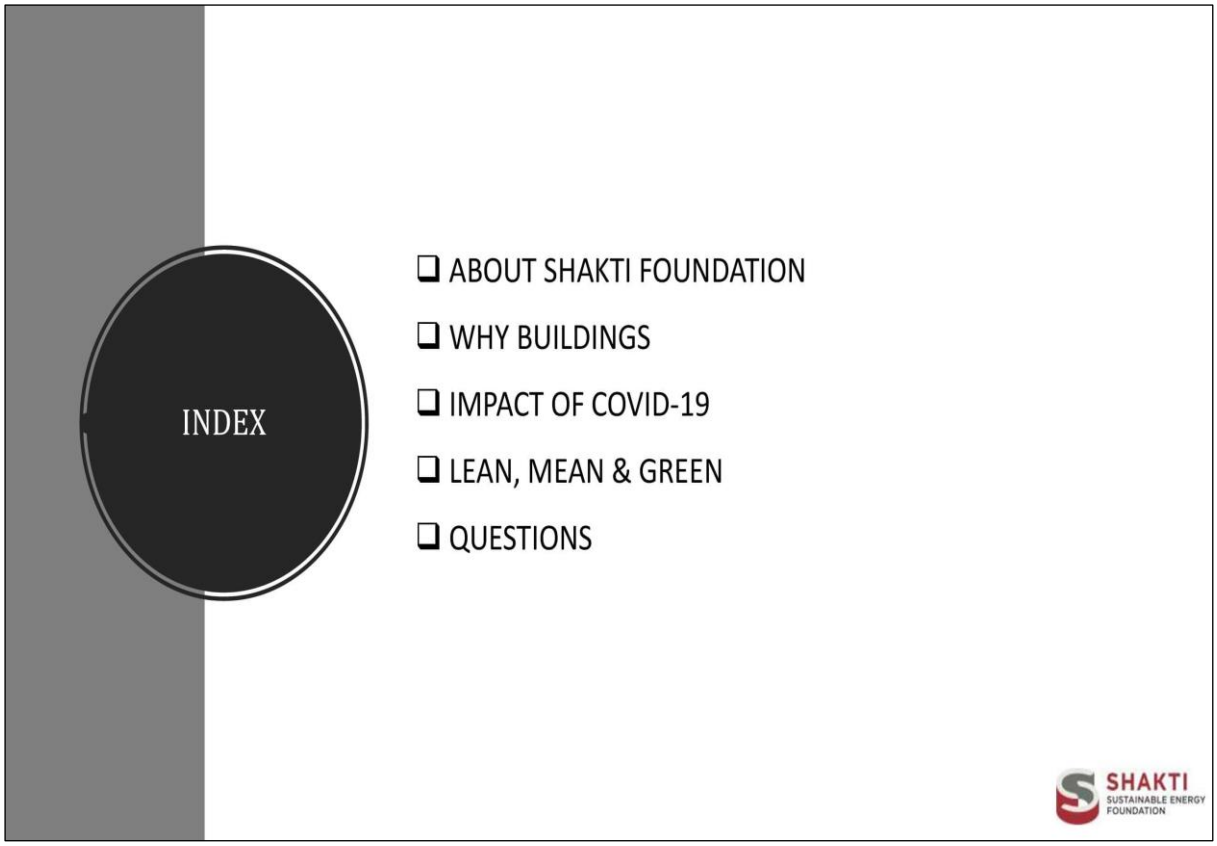
List of Presenters\ Resource Persons

Sr. No.	Name	Designation	Organization	Email address
1.	Mr Shubhashis Dey	Associate Director, Energy Efficiency Program	Shakti Sustainable Energy Foundation India	shubhashis@shaktifoundation.in
2.	Dr Mohammad Adil	Deputy Director	Center for Industrial and Building Energy Audits (CIBEA), UET Peshawar Pakistan	adil@uetpeshawar.edu.pk
3.	Dr Guozhu Li	Deputy Director	China Academy of Building Research China	liguozhu50@163.com
4.	Dr Muhammad Bilal Sajid	Assistant Professor	US Pakistan Center for Advanced Studies in Energy (USPCAS-E) NUST Pakistan	mbilalsajid@gmail.com

Presentations Delivered During the Webinar

Mr Shubhashis Dey, Associate Director, Energy Efficiency Program in Shakti Sustainable Energy Foundation India





ABOUT SHAKTI FOUNDATION

SHAKTI SUSTAINABLE ENERGY FOUNDATION

SHAKTI SUSTAINABLE ENERGY FOUNDATION

- OUR VISION | A clean and secure energy future
- OUR MISSION | Facilitating a sustainable energy future for India by promoting policies that encourage renewable energy, energy efficiency, sustainable urban transport and sustainable finance
- THE POLICY FOCUS| We believe that effective energy policy frameworks are necessary for large-scale, transformative change.
- OUR WORK | We work with policy makers, civil society, research institutions , think tanks and the private sector to develop policy solutions for energy and climate challenges

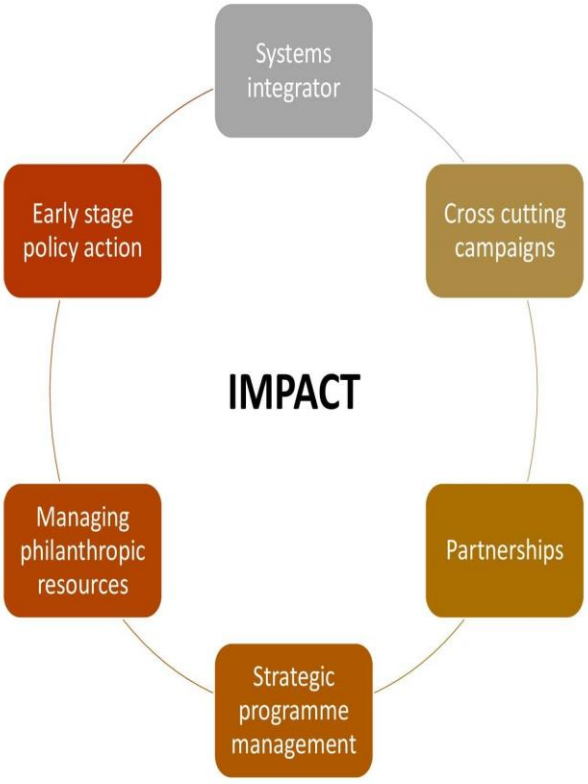
SHAKTI SUSTAINABLE ENERGY FOUNDATION

WHY SHAKTI

- Ability to create positive policy momentum
- Investments focus on large scale change.
- Strong relationships with over 100 partners
- Established and tested grant management and compliance processes
- Credibility with Policy Makers at the Central, State and City level

SHAKTI SUSTAINABLE ENERGY FOUNDATION

OUR APPROACH



SHAKTI SUSTAINABLE ENERGY FOUNDATION

KEY FOCUS AREA

Energy Efficiency

Energy Efficient and Climate Friendly Cooling

Buildings & Appliances

Industry

Climate Policy

Low Carbon Development

Air Quality Management

Clean Power

Electric Utilities

Energy Access

Renewable Energy

Sustainable Finance

Financial Market Regulations

Financial Products and Instruments

Sustainable Transportation

Systems & Planning

Vehicles & Fuels

Electric Vehicles

SHAKTI SUSTAINABLE ENERGY FOUNDATION

KEY OUTCOME

Shakti-supported efforts have greatly informed the development of the India Cooling Action Plan (ICAP), a comprehensive roadmap to address the country's burgeoning cooling requirements over the next 20 years. Shakti helped to form a civil society coalition on cooling – India Cooling Coalition. Members of the coalition led four of the thematic working groups working on the ICAP and had representation across all six working groups. Shakti also supported its grantee partners over the last two years to create a fact-base on clean cooling through research and analysis, which fed into the preparation of the ICAP.

SHAKTI SUSTAINABLE ENERGY FOUNDATION

KEY OUTCOME

Shakti's support has led to the inclusion of building sector (Hotels) as designated consumers during the 4th cycle of Perform Achieve and Trade (PAT). PAT is a mandatory market-based mechanism to enhance energy efficiency in energy intensive sectors by making efficiency a tradable commodity.

KEY OUTCOME

The wholesale price of the highly energy efficient 9W LED bulbs dropped to less than INR 75 – making it affordable for consumers and unlocking considerable energy savings for India. Shakti worked with multiple partners to pave the way for the large-scale adoption of LED bulbs.

Now, under the national program for LED-based Home and Street Lighting launched by Govt. of India over 360 million LED bulbs have been distributed and a further 200 million LED bulbs have been sold by the private sector.

WHY BUILDINGS

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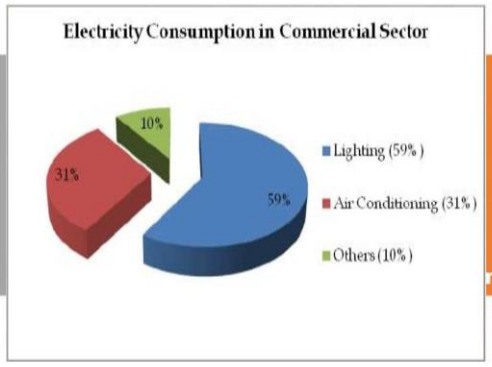
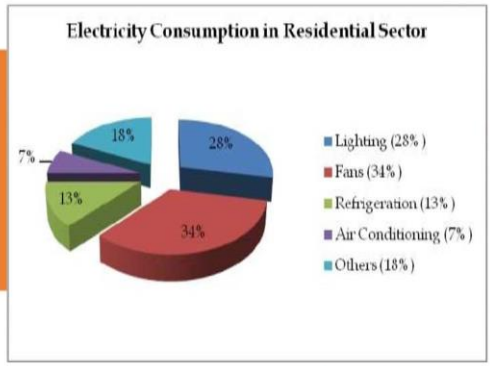
WHY BUILDINGS

CONSUMPTION OF ELECTRICITY BY SECTORS IN INDIA (2017-18)

Source: MOSPI Energy Statistics 2019 ; INDIA Second Biennial Update Report





Source: Bureau of Energy Efficiency

- Lighting, cooling (AC & fans) and refrigeration are the major load

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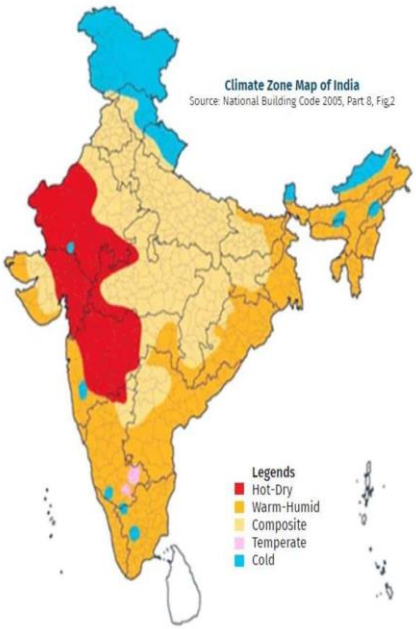
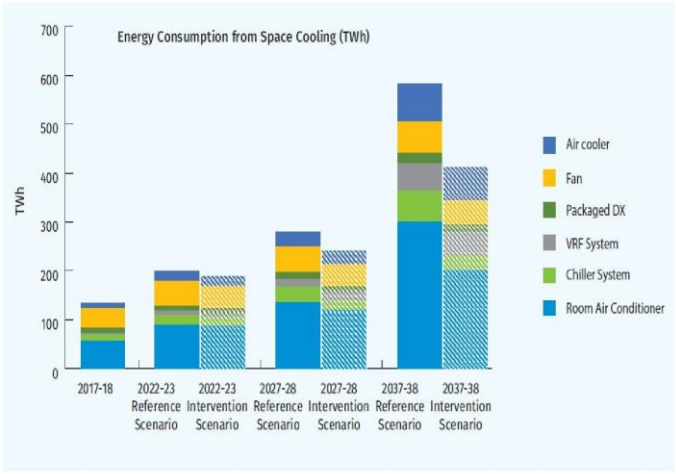
IDENTIFY LARGE CONTRIBUTORS

- Penetration of AC in India is expected to increase from the current level of 6-8% to around 50% in next 25-30 years. Hence, making cooling load substantially higher then others.





Annual Energy Consumption from Space Cooling in Buildings

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IMPACT OF COVID-19

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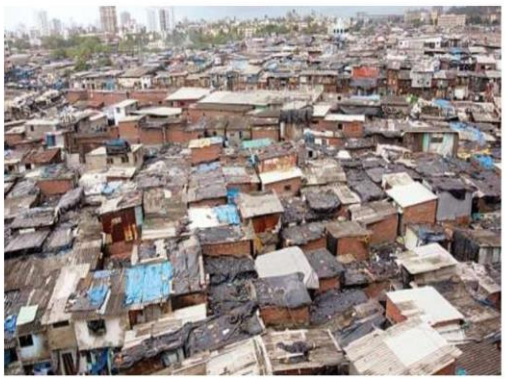
PANDEMIC AND HOUSING

- In majority of Indian cities which are worst effected by the current pandemic; the urban slums, unauthorized colonies and densely populated areas with poor building designs became the hot bed for Covid-19 infection.
- Unavailability of safe, healthy and affordable houses in cities was one of the principle reason for reverse migration of migrant workers in India.
- The spread of Covid-19 infection in India indicates that during a pandemic where self isolation is required, the design and quality of a home and neighbourhood is a key contributor to the health and wellbeing of the people who live there.

Covid19 hotspot Jahangirpuri, Delhi (Photograph: AajTak)



Covid19 hotspot Dharavi, Mumbai (Photograph: DNA)

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STIMULUS PACKAGES: OPPORTUNITY TO ACT

Real estate sector finds an important place holder within the INR 20,000 Billion stimulus package announced by Government of India. Few examples:

PMAY subsidy scheme extension

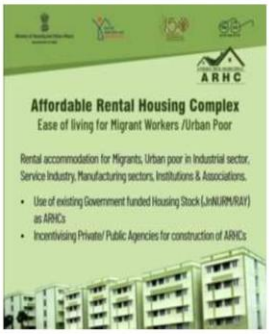
The Indian Finance Minister, Nirmala Sitharaman on May 14 announce the extension of Pradhan Mantri Awas Yojana (PMAY) subsidy scheme to FY 21. This will facilitate investment of INR 70,000 crore in housing projects for the mid-income group.

Credit for real estate

INR 300 Billion special liquidity scheme for Non-Banking Finance Companies (NBFCs) and Home Finance Companies (HFCs) and Micro Finance Institutions (MFIs).

Affordable rental housing scheme

An affordable rental housing scheme (ARHC) through a Public – Private Partnership (PPP) mode will be launched to provide rental accommodation to migrant workers, students and the urban poor providing them with a healthy living condition. Industries, manufacturing units and institutions will also be incentivised to develop AHRC on their land that is unutilised under PPP mode. This housings may deter migrants to reverse migrate when faced with calamity or pandemic such as COVID-19.



These stimulus packages provides us with an excellent opportunity to advise policy makers to introduce building energy conservation principles (focusing on thermal and visual comfort) in the design and construction of millions of new homes and prevent long-term lock-ins into fossil-fuels based technologies.

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KEY FOCUS

	Embodied Energy	Thermal Comfort	Operational Energy
Direct impact	India is yet to build about 75% of the buildings expected to exist in India in 2030.	Indoor thermal comfort is a function of building design and building materials used. Poor indoor thermal comfort creates higher demand of energy for indoor air conditioning	Energy efficient appliance to reduce building electricity demand
	Around 1.2 million new urban homes will be built under PMAY by 2022.		Rooftop solar to reduce dependence on fossil fuel based grid supply
	India offers a huge opportunity to avoid carbon lock-in associated with new buildings.		
Indirect impact	Real estate sector is a major consumer of products manufactured by harder to abate sectors like steel, cement and brick	Impacts productivity, health and wellbeing of the occupants. Critical for future calamities or pandemics like Covid19	Reduce green house gas emission and air pollution from diesel / thermal power generation

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ENABLER

The National Building Code of India (NBC) 2016, is a National Instrument providing guidelines for regulating the building construction activities across the country. It contains administrative regulations, development control rules and general building requirements; fire safety requirements; stipulations regarding materials, structural design and construction (including safety); building and plumbing services; **approach to sustainability**; and asset and facility management.

The ECBC 2017 provides current as well as futuristic advancements in building technology to further reduce building energy consumption and promote low-carbon growth. The code aims to optimise energy savings with the comfort levels for occupants and prefers life-cycle cost effectiveness to achieve energy neutrality in commercial buildings.

ECO Niwas Samhita 2018, an Energy Conservation Building Code for Residential Buildings (ECBC-R), aims to benefit the occupants and the environment by promoting energy efficiency in design and construction of homes, apartments and townships.

The India Cooling Action Plan (ICAP) 2019 provides a 20-year perspective (2017-18 to 2037-38) and recommendations, to address the cooling requirements across sectors and ways and means to provide access to sustainable cooling.

India focused Green Building Codes are available for both commercial and residential buildings e.g. Indian Green Building Code, GRIHA etc.

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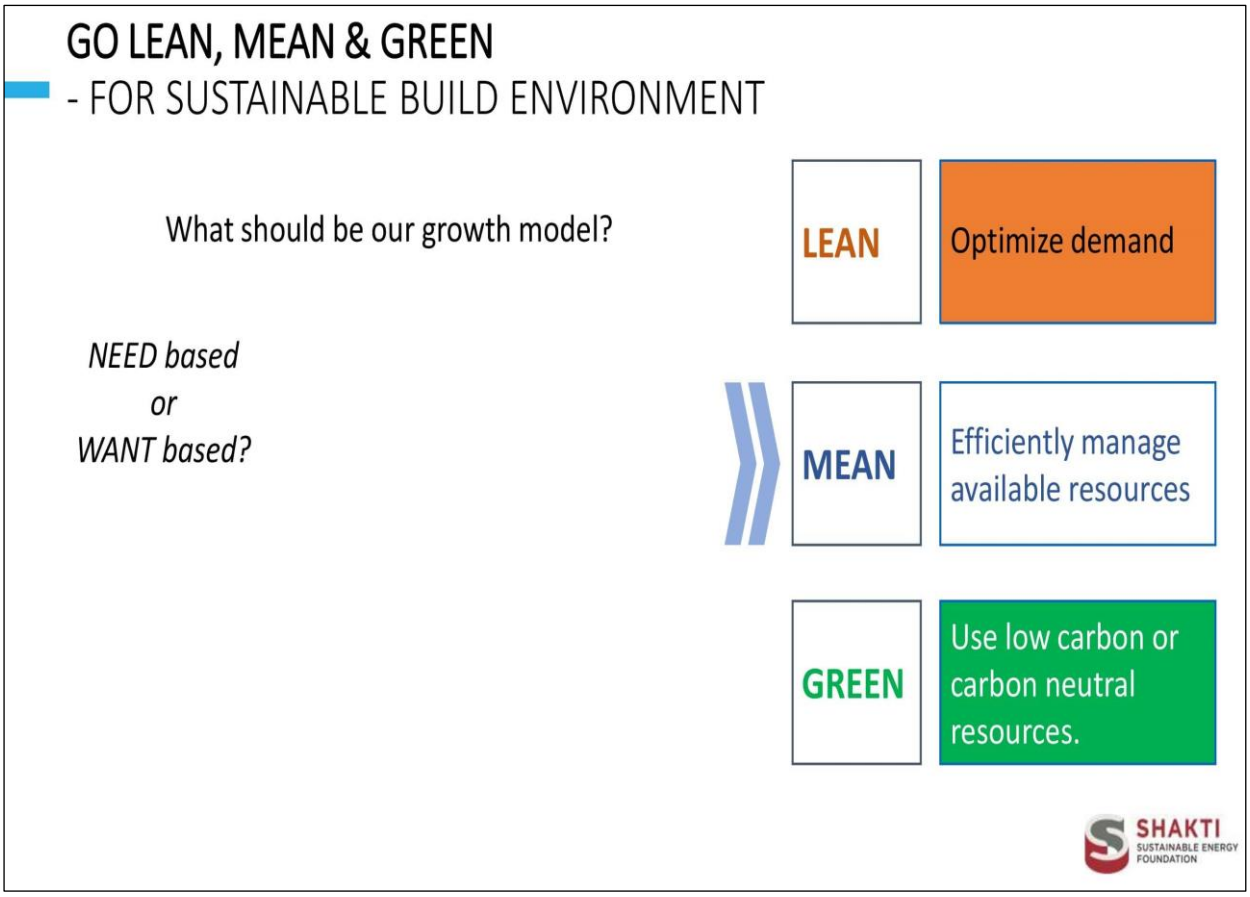
GO LEAN, MEAN & GREEN
- FOR SUSTAINABLE BUILD ENVIRONMENT
What should be our growth model?
NEED based
or
WANT based?
LEAN
Optimize demand
MEAN
Efficiently manage available resources
GREEN
Use low carbon or carbon neutral resources.
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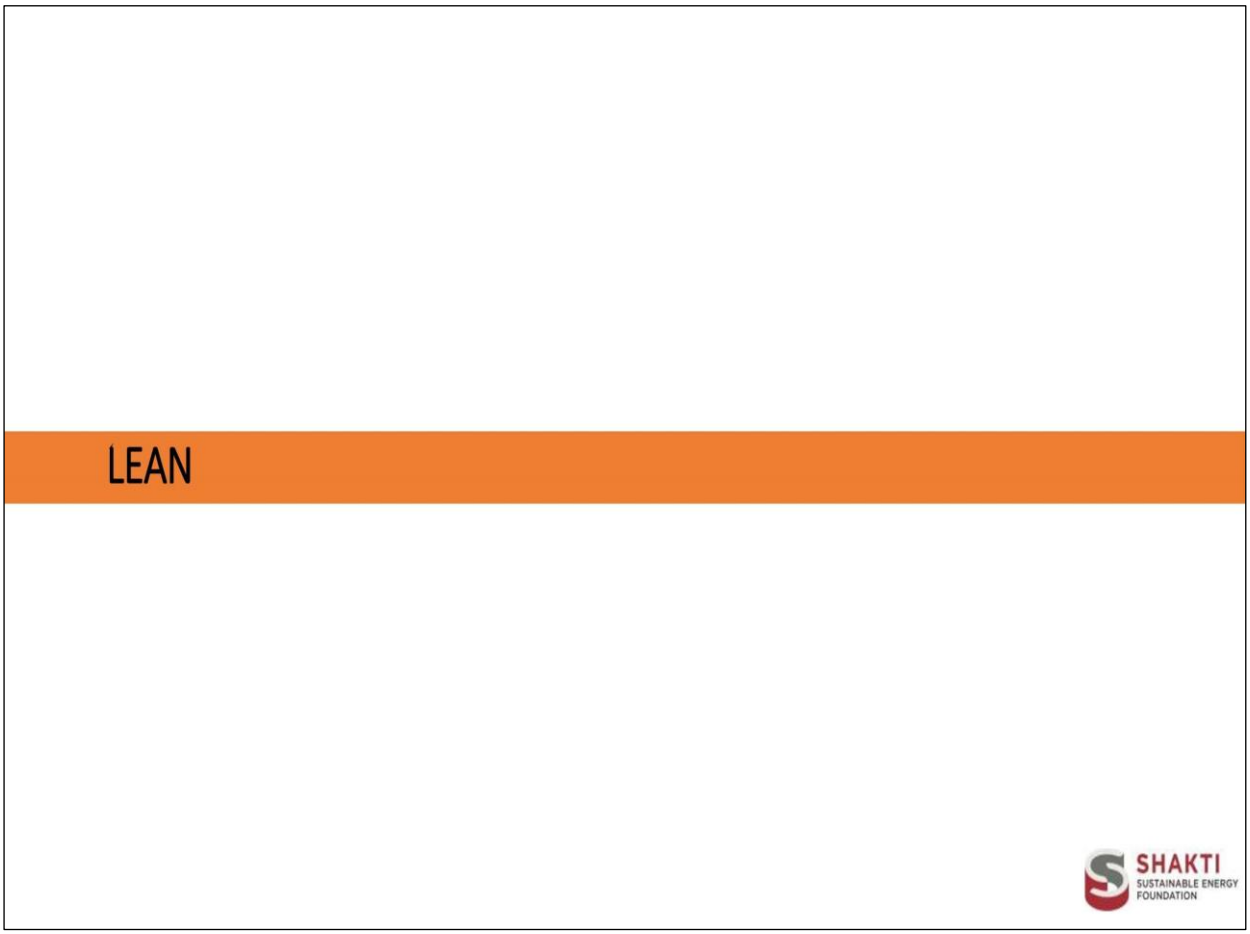
LEAN
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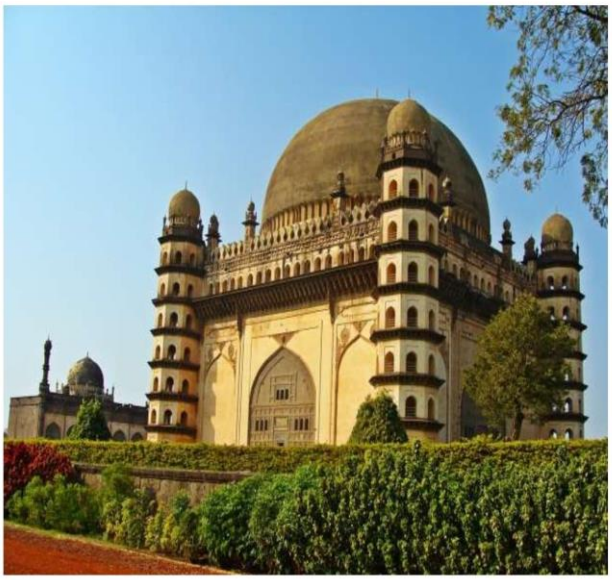
REDEFINING HISTORY OF ART AND ARCHITECTURE

Can we do a green rating for old buildings? Is an EPI (energy performance index) of the Gol Gumbaz possible?



- How would these buildings fare if the ECBC were to be enforced on them?
- User experiences documented in comparative structures
- Recent research on energy efficiency in historical buildings, is shifting more towards Life Cycle Assessments compared the approach of operational energy studies.

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REDEFINING HISTORY OF ART AND ARCHITECTURE

Integrating old techniques in new buildings and technologies

Use of Jallis / fenestrations

Pearl Academy of Fashion
http://www.treehugger.com/

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REDEFINING HISTORY OF ART AND ARCHITECTURE

SECMOL campus, Ladakh: Combination of traditional knowledge and modern architecture.

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ARCHITECTURE & URBAN DESIGN

Tradition vs Modern

This is NOT meant to be a battle between traditional and modern forms of architecture.

Every district has its own traditions and, by trial and error, over thousands of years, people have learned how to use, and to cope with, all the many factors which are involved in Architecture. – The Site, the Topography and Geology.

It is foolish, therefore, to abandon the tested findings of centuries of "Science & Technology."

- Laurie Baker

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MEAN

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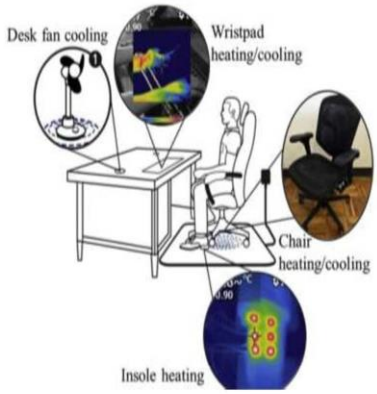
PROMISING COOLING TECHNOLOGIES

Building Level

- Radiant cooling (slab/chilled beams)
- Building level assisted ventilation systems
- Individual RAC with centralized water-cooled condensers system

Personal Systems

- Wearable – Cooling Technology
- Personal Thermal Comfort Systems



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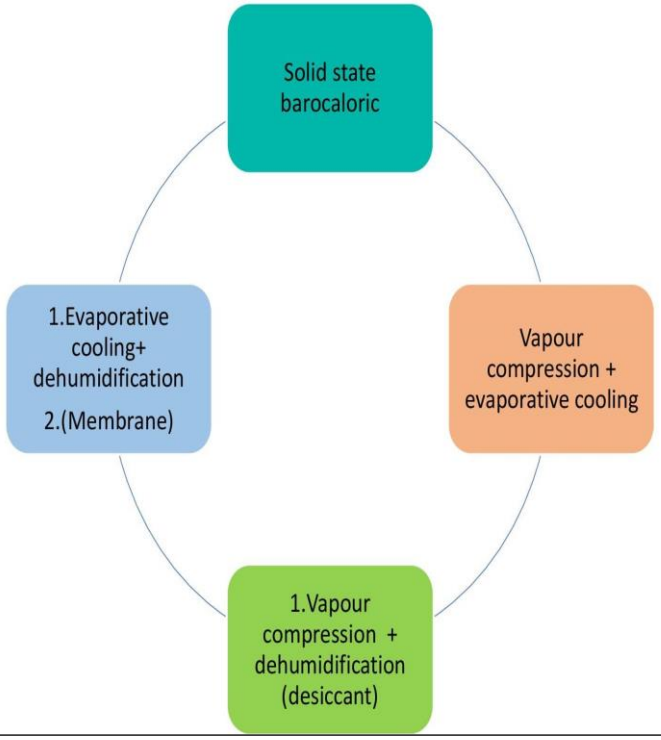
PROMISING FUTURE TECHNOLOGIES (RAC): GLOBAL COOLING PRIZE EIGHT FINALISTS



Global Cooling Prize
Room Air Conditioners (RAC) solutions

- 80% lower climate impacts
- 60% reduction in maximum power drawn

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RADIANT COOLING AND SLAB TEMPERING SYSTEMS

Option 1: Considerable first cost but provides high degree of thermal comfort

Roof Level, Living & Learning Design Center, Kutch

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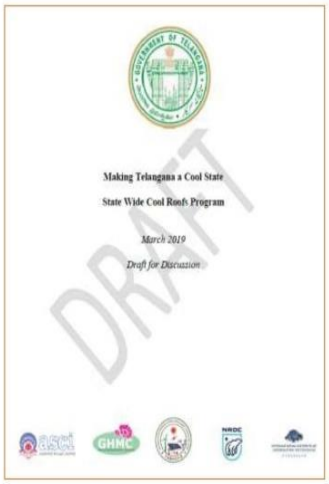
COOL ROOFS

Option 2: Affordable and provides thermal comfort



Cool Roof, Hyderabad
(Photograph: Deccan Chronicle)

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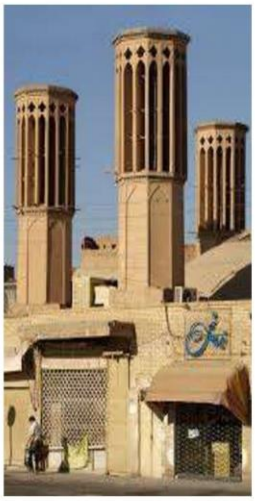
GREEN

SHAKTI SUSTAINABLE ENERGY FOUNDATION

RENEWABLE ENERGY INTEGRATION IN BUILDING

Rooftop solar photovoltaic plant

Rooftop solar water heater



Wind Towers

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NATURAL REFRIGERANTS: TYPES

Natural Refrigerants can be divided into :

- Hydrocarbons – Propane (R290), Propylene (R1270), R600a
- Ammonia
- Carbondioxide
- Isobutene

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QUESTIONS

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Thank you

Shubhashis Dey
Associate Director
shubhashis@shaktifoundation.in
+91 9810554822

SHAKTI SUSTAINABLE ENERGY FOUNDATION

Energy Wastage and Recovery Options in Buildings

WEBINAR SAARC ENERGY CENTRE

23/06/2020

Dr. Mohammad Adil

Deputy Director

www.CIBEA.com.pk

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1

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Today!

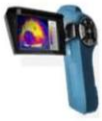
- Introduction
- Building Energy Wastage
- CIBEA's study on Building Energy Wastage in Peshawar City.
- Use of Building Information Modelling in Energy wastage control.

2

Equipment at CIBEA

11. Blowerdoor

1. Energy Analyzer (KW, KVA, PF, Harmoics)



2. Thermal Imager Baltech TR-0120

3. Anemometer EXTECHAN 340

4. Anenometer Dwyer VT-200

5. Video Boroscope EXTECH BR 250-4

6. Laser Range Finder

7. Moisture Humidity Meter EXTECH MO 295

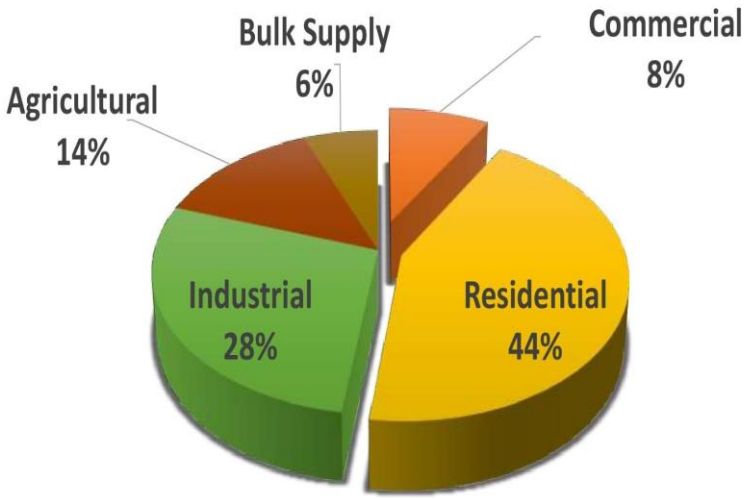
8. IR Thermometer Fluke 572-2

9. Laser Distance Meter Fluke 419 D

10. Flue Gas Analyzer Testo 320

3

Sector-wise Energy Consumption in Pakistan

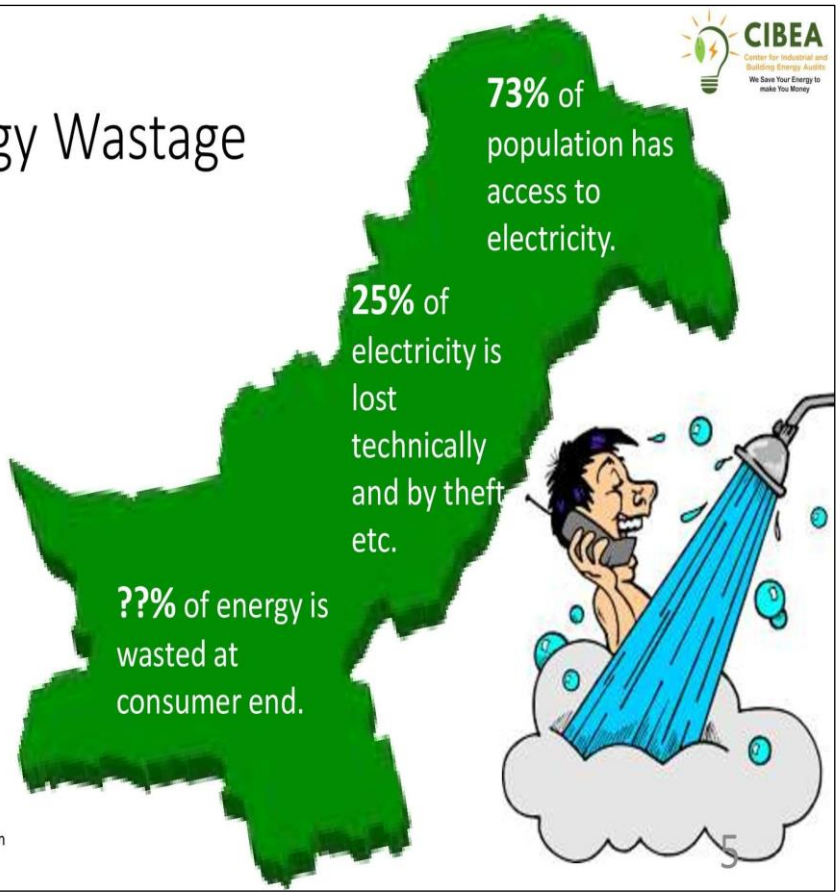


https://www.researchgate.net/publication/262937628_Smart_Grids_An_approach_to_integrate_the_Renewable_Energies_and_Efficiently_Manage_the_Energy_System_of_Pakistan

4

Building Energy Wastage

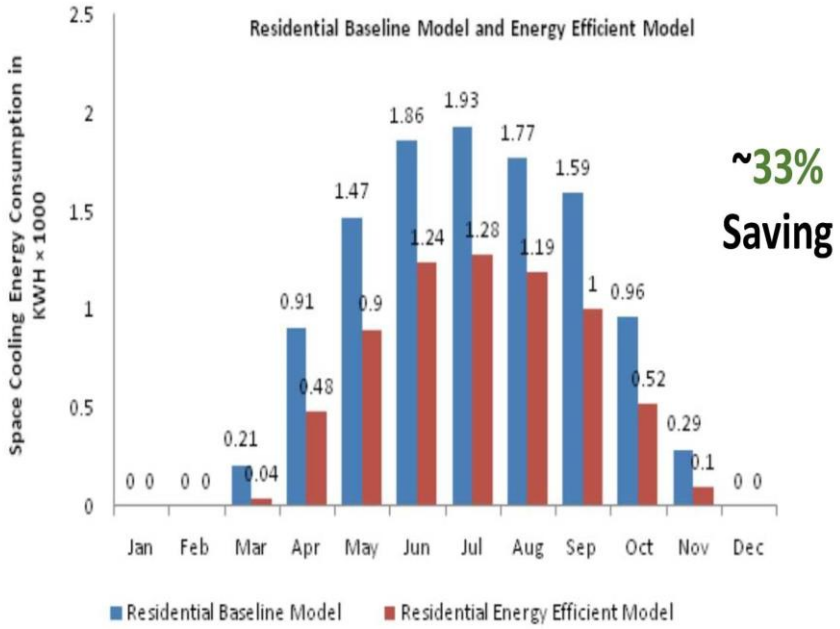
In Pakistan,



https://energypedia.info/wiki/Pakistan_Energy_Situation

5

Energy Saving with Energy Efficient Equipment

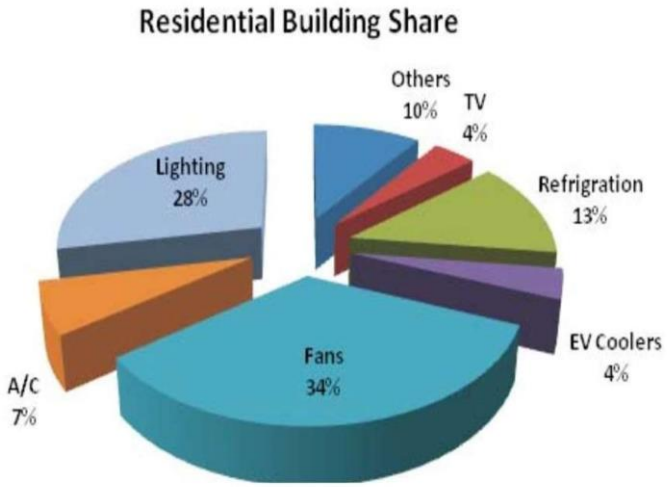


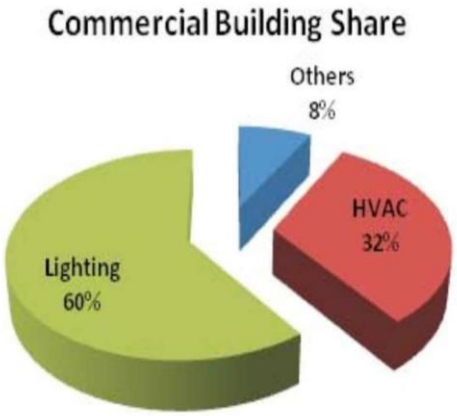
~33% Saving

Energy Efficient Residential Buildings in Pakistan Article in Energy & Environment · July 2014 DOI: 10.1260/0958-305X.25.5.991
Khurshid Ahmad, Amer Farhan Rafique, Saeed Badshah

6

Energy Consumption in Buildings





The Bureau of Energy Efficiency (BEE), 2008

7

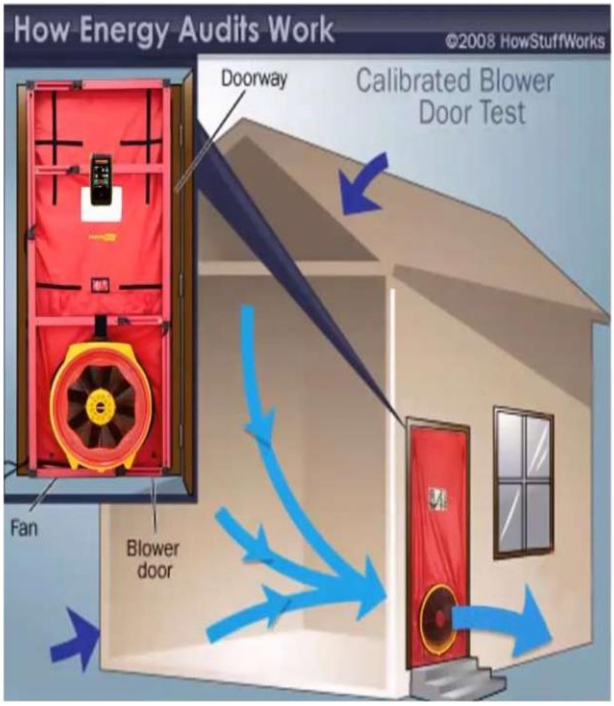
Question remains!

- **How much energy is wasted in/by building (design)?**

Consuming this wasted energy will reduce demand on providers.

8

Blowerdoor Test



9

Blowerdoor Test

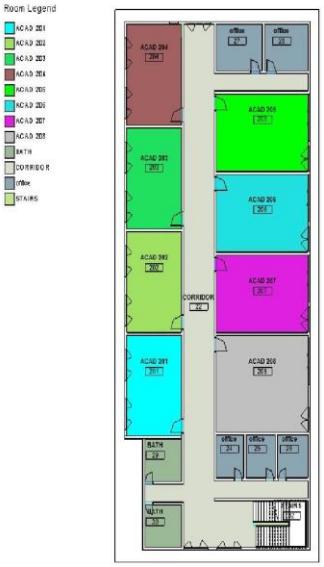
Team CIBEA setting the blowerdoor equipment

Taking depressurization readings

10

Blowerdoor Test Commercial Building A

Rooms Layout



11

Blowerdoor Test Commercial Building A

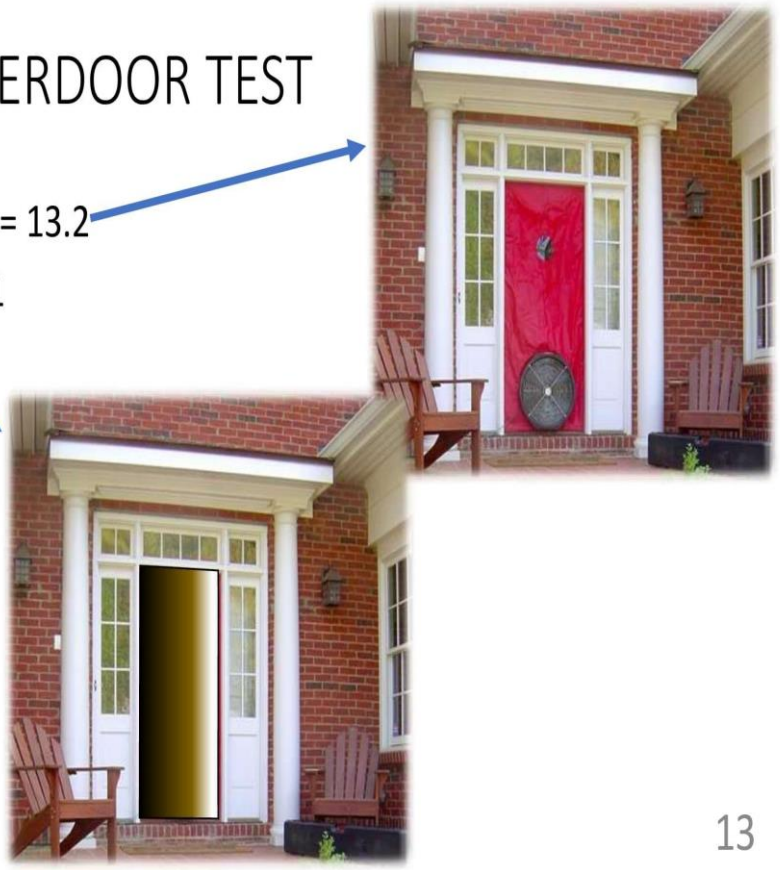
Room #	Airflow at 50 pa,cfm @50	Air changes at 50 pa, n50 (/h at 50 pa)	Effective leakage area at 4 pa (cm^2)	Equivalent leakage area at 10 pa(cm^2)	LEED permeability at 4 pa (cm^2/100m^2)	Volume (m^3)	Floor area (m^2)	Enclosure area (m^2)
ACAD 101*	1040.6	13.98	396.2	726	247	126.5	41.4	160.4
ACAD 102	875.1	11.94	319.5	594.5	199.1	126.5	41.4	160.4
ACAD 103	1040.6	13.98	396.2	726	247	126.5	41.4	160.4
ACAD 104*	1267.5	17.02	512	918.5	319	126.5	41.4	160.4
ACAD 105	998.79	10.19	321.7	626.5	158.4	166.6	56.1	203.1
ACAD 106*	1157	11.8	364.9	716.1	179.7	166.6	56.1	203.1
ACAD 107	1171.5	11.78	468.5	843.5	230.5	166.6	56.1	203.1
ACAD 108	1157	11.8	364.9	716.1	179.7	166.6	56.1	203.1
ACAD 201*	1116.7	15	444.1	801.2	276.8	126.5	41.4	160.4
ACAD 202*	1040.6	13.98	396.2	726	247	126.5	41.4	160.4
ACAD 203	1116.7	15	444.1	801.2	276.8	126.5	41.4	160.4
ACAD 204	1267.5	17.02	512	918.5	319	126.5	41.4	160.4
ACAD 205*	998.79	10.19	321.7	626.5	158.4	166.6	56.1	203.1
ACAD 206	1344.3	13.71	349.7	735.9	172.2	166.6	56.1	203.1
ACAD 207*	1171.5	11.78	468.5	843.5	230.5	166.6	56.1	203.1
ACAD 208	1200.1	12.24	488.5	873.9	240.5	166.6	56.1	203.1

* Values are not measured but are taken from similar room's data

12

FROM BLOWERDOOR TEST

- **ACH @ 50** PASCAL = 13.2
- LBL N Factor = 9.71
- n ACH =1.36



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Blowerdoor Test Commercial Building A

Comparison of heating and cooling load for 1.36 and 0.5 ACH

HEATING AND COOLING LOAD FOR 1.36 ACH	
Peak Cooling Total Load (Btu/h)	413,147.4
Peak Cooling Airflow (CFM)	12,290
Peak Heating Load (Btu/h)	111,755.3
Peak Heating Airflow (CFM)	2,361

HEATING AND COOLING LOAD FOR 0.52 ACH	
Peak Cooling Total Load (Btu/h)	366,606.1
Peak Cooling Airflow (CFM)	12,222
Peak Heating Load (Btu/h)	75,991.4
Peak Heating Airflow (CFM)	2,158

Average ACH @ 50 pa = 13.21
Which when Converted to Natural ACH becomes 1.36

Similarly,
Natural ACH = 0.52
Which when Converted to ACH @ 50 pa becomes 5 ACH

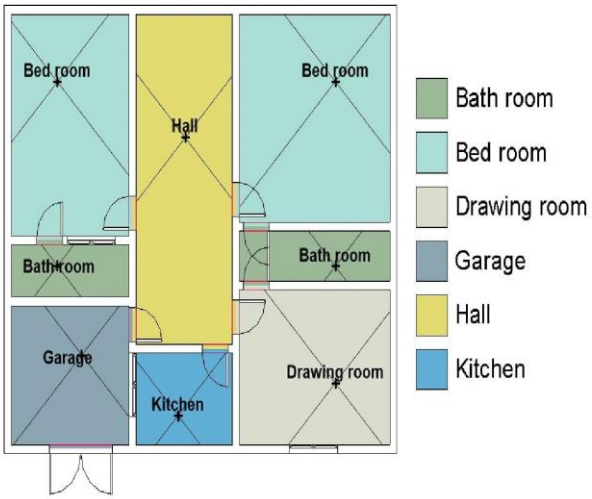
If we make the rooms air tight and reduce ACH @ 50 pa from 13.21 to 5 ACH the peak heating and cooling loads reduces.

Difference in peak Cooling load = **46541.3 (btu/h)**

Difference in peak Heating load = **35763.9 (btu/h)**

15

Blowerdoor Test Residential Building B



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FROM BLOWERDOOR TEST

- **ACH @ 50** PASCAL = 34
- LBL N Factor = 14.28
- n ACH =2.38

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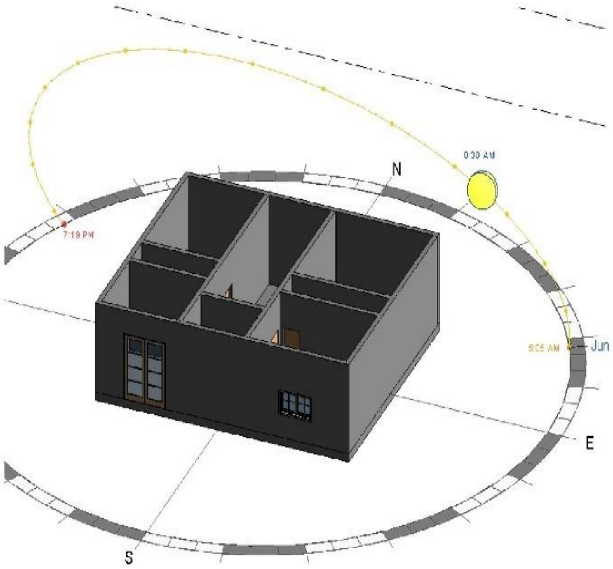
BIM Model in Revit and Energy Analysis



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Blowerdoor Test Residential Building A

Comparison of heating and cooling load for 2.38 and 0.5 ACH

HEATING AND COOLING LOAD FOR 2.38 ACH	
Peak Cooling Total Load (Btu/h)	18,330.4
Peak Cooling Airflow (CFM)	452
Peak Heating Load (Btu/h)	15,855.7
Peak Heating Airflow (CFM)	483

HEATING AND COOLING LOAD FOR 0.52 ACH	
Peak Cooling Total Load (Btu/h)	13,396.2
Peak Cooling Airflow (CFM)	452
Peak Heating Load (Btu/h)	10,067.6
Peak Heating Airflow (CFM)	454

ACH @ 50 pa = 34 which when Converted to Natural ACH becomes 2.38

Similarly,
Natural ACH = 0.52
Which when Converted to ACH @ 50 pa becomes 7 ACH

If we make the rooms airtight and reduce ACH @ 50 pa from 34 to 5 ACH the peak heating and cooling loads reduces.

Difference in peak Cooling load = **4934.2 (btu/h)**

Difference in peak Heating load = **3328.6 (btu/h)**

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Finally

RESIDENTIAL BUILDINGS

- The reduction in cooling load due to infiltration control is around **25 %** of the total cooling load.
- And the reduction in heating load is around **21%** of total heating load.

COMMERCIAL BUILDINGS

- The reduction in cooling load due to infiltration control is around **12 %** of the total cooling load.
- And the reduction in heating load is around **32%** of total heating load.

20

BIM+ BLOOWER DOOR Audit

Is a possible way of reducing **12-32%** of energy wastage *in heating and cooling*

or

7-17% *reduction of the total energy demand* in all sectors combined.

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THANK YOU

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Any Questions

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Webinar on Designing Energy Efficient Buildings in SAARC Region

Development of Green Building in China and Main Technical Standards

中国绿色建筑发展与主要技术标准

Dr. Guozhu LI
Deputy Director / Associate Professor
China Academy of Building Research

李国柱 博士
副所长 / 副研究员
中国建筑科学研究院有限公司

中国建筑科学研究院有限公司
China Academy of Building Research

Dr. Guozhu Li

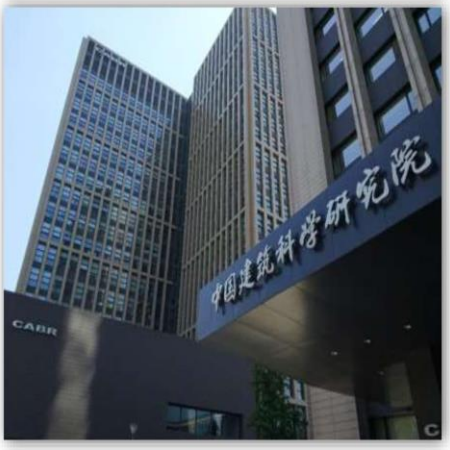
- Deputy Director, Institute of Science and Technology Research and Development, China Academy of Building Research;
- Deputy secretary-general, Green Building and Eco-district Branch, China Association for Engineering Construction Standardization;
- Senior Member, Green Building Council of Chinese Society for Urban Studies;
- Member, Youth Committee of Indoor Environment and Health Branch, Chinese Society for Environmental Sciences;
- Secretary, China Industry Technology Innovation Strategic Alliance for Healthy Building

李国柱 博士

- 中国建筑科学研究院有限公司 科技发展研究院，副所长
- 中国工程建设标准化协会 绿色建筑与生态城区分会，副秘书长
- 中国城市科学研究会绿色建筑与节能专业委员会，高级会员
- 中国环境科学学会室内环境与健康分会青年委员会，委员
- 中国健康建筑产业技术创新战略联盟，秘书

中国建筑科学研究院有限公司
China Academy of Building Research

A Brief Introduction of China Academy of Building Research (CABR)



China Academy of Building Research (CABR) was founded in 1953.

CABR is now the largest comprehensive R&D institution in the building industry of China.

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China Academy of Building Research

A Brief Introduction of China Academy of Building Research (CABR)

Main business:

(1) Carry out common, basic and public **technical research** to put forward solutions for key technical problems.

(2) Develop and manage main **technical standards and codes** for building industry of China.

(3) Exercise **quality supervision and testing** on construction, air-conditioning equipment, solar water heater, elevator, building materials and building energy efficiency.

(4) Develop new technologies and products for the market, **provide services** in the fields of design, urban planning, quality inspection of construction engineering and products, R&D and production of new technologies and products, and engineering contracting.

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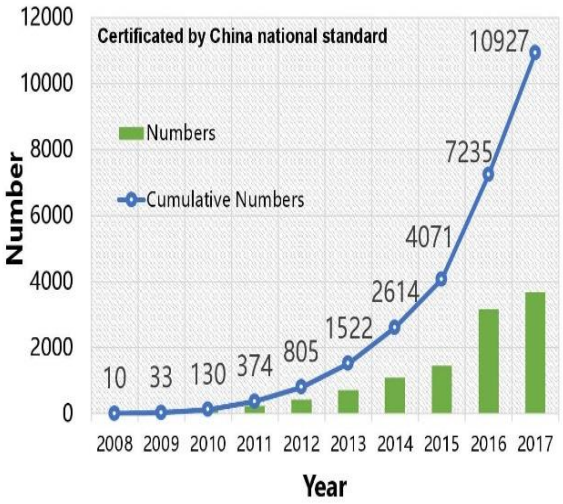
1、Overview of Status



Number of green buildings in China

- In recent years, practice of green building in China is steadily promoting.
- The whole society has gradually improved the concept and understanding of green buildings.
- The number of green buildings goes up rapidly year by year. As of 2017, a total of **10927** green buildings have been certificated, with a area of more than **1 billion m^2**.
- As of 2018, the total area of green buildings in China reached **2.5 billion m^2**.
- The green buildings account for **56%** within the whole new buildings in 2018.

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1、Overview of Status

The benefits of green building represent obviously:

Analyzed from the operation data of 200 green building projects :

- Average ratio of energy-saving: **58%**
- Average ratio of green space: **38%**
- Average ratio of water saving: **15.2%**
- Average ration of recyclable materials utilization: **7.7%**
- Average CO_2 emission reduction: **28.2 kg/m²**

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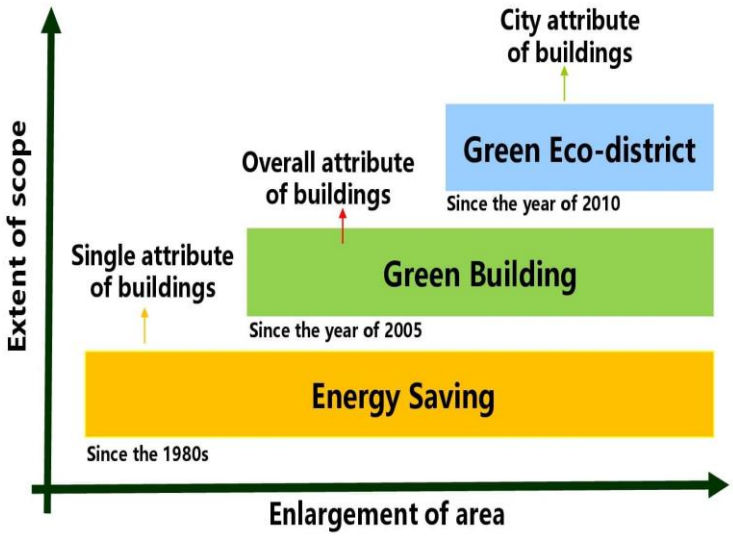
1、Overview of Status

Upgrade: Energy Saving-Green Building-Green Eco-district



- Expand the green development scope from single building to a district.
- The sustainable development covers the buildings and cities.
- Nowadays, almost all the new buildings in China shall meet the requirements of green building.

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1、Overview of Status

The promotion of green building in China is a very successful practice.

Why is the development of green building in China so fast and sustainable?

How does the green building development grow?

What has been done to promote the development of green building?

- ✓The policy support is the driven force.
- ✓The technical research is the guarantee .
- ✓The improving standard system is the basic.
- ✓The certificated projects is the experience source.

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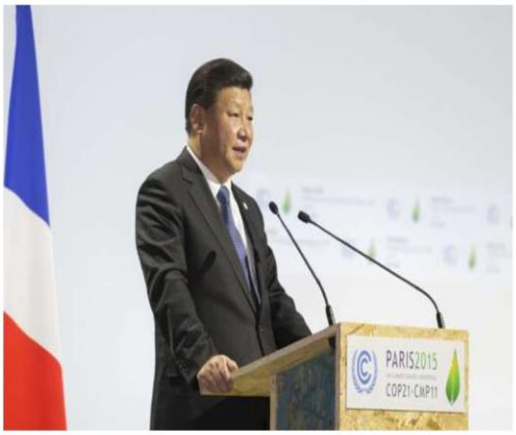
2、Policy Promotion

- Leaders value green development.
- According to the speech delivered by **Chinese President Xi Jinping** in World Climate Change Conference 2015 (COP21), **developing green building** is one of the ways to form a new pattern of the harmony between human and nature.



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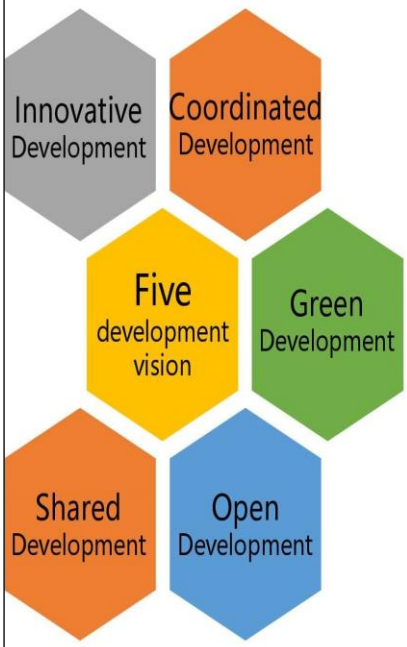
2、Policy Promotion



- **Green Development** is one of the five development vision of China.
- New Architecture Principle of China: Applicable, Economical, **Green** and Beautiful.

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2、Policy Promotion

National Policies

- 2006.2《国家中长期科学和技术发展规划纲要（2006-2020年）》（国发〔2006〕6号）
  National Mid-term and Long-Term Science and Technology Development Plan(2006-2020)
- 2012.4《关于加快推动我国绿色建筑发展的实施意见》（财建〔2012〕167号）
  Implementation Suggestions on Accelerating Green Building Development
- 2012.5《"十二五"绿色建筑科技发展专项规划》（国科发计〔2012〕692号）
  The "Twelfth Five-Year Plan" for Technological Development of Green Building
- 2013.1《绿色建筑行动方案》（国办发〔2013〕1号）
  Green Building Action Plan
- 2013.4《"十二五"绿色建筑和绿色生态城区发展规划》（建科[2013]53号）
  Development Plan for Green Building and Green Ecological Urban Areas during the "Twelfth Five-year Plan" Period
- 2013.12《关于保障性住房实施绿色建筑行动的通知》（建办[2013]185号）
  Notice on Implementing Green Building Action of Security Housing
- 2014.3《国家新型城镇化规划（2014-2020年）》
  National New-type Urbanization Plan (2014-2020)

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2、Policy Promotion

National Policies

- ◆ 2014.6《能源发展战略行动计划（2014-2020年）》（国办发〔2014〕31号）
  Energy Development Strategy Action Plan (2014-2020)
- ◆ 2014.10《关于在政府投资公益性建筑及大型公共建筑建设中全面推进绿色建筑行动的通知》（建办科[2014]39号）
  Notice on Comprehensively Promoting the Green Building Action in Public Service Buildings and Large Public Buildings Construction Invested by the Government
- ◆ 2015.2《关于开展"十三五"国家重点研发计划优先启动重点研发任务建议征集工作的通知》（国科发资〔2015〕52号）
  Notice about Carrying Out the Suggestions Collection Work of the "13th Five-Year Plan" National Important Research Plan Preferentially Starting Important Research Tasks
- ◆ 2016.2《城市适应气候变化行动方案》（发改气候〔2016〕245号）
  Urban Adaptation to Climate Change Action Plan
- ◆ 2016.2《关于进一步加强城市规划建设管理工作的若干意见》
  Several Opinions on Further Strengthening the Urban Planning and Construction Management
- ◆ 2017.3《建筑节能与绿色建筑发展"十三五"规划》
  The 13th Five-Year Plan for Development of Building Energy Conservation and Green Building

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2、Policy Promotion

National Policies

□《国家中长期科学和技术发展规划纲要（2006-2020年）》中，将"建筑节能与绿色建筑"作为重点领域"城镇化与城市发展"下的优先项目。提出中国绿色建筑发展总体战略目标是以实现国家"十一五"规划约束性指标为契机，促进绿色建筑发展，大力发展节能省地型住宅，通过实现绿色建筑的"四节一环保"推动中国可持续发展。

National Mid-term and Long-Term Science and Technology Development Plan (2006-2020) made "building energy-saving and green building" as the priority project under the important areas of "urbanization and urban development". We will promote the sustainable development of China through the realization of green building's "four saving and one environmental protection".

According to this policy, many technology research projects conducted to promote the development of technologies.

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2、Policy Promotion

National Policies

- 《建筑节能与绿色建筑发展“十三五”规划》，全面推动绿色建筑发展量质齐升，到2020年城镇新建建筑中绿色建筑面积比重超过50%。十三五期间，获得绿色建筑评价标识项目中，二星级及以上级项目比例超过80%，获得运行标识项目比例超过30%。

The 13th Five-Year Plan for Development of Building Energy Conservation and Green Building:

The **amount** and **quality** of green building to be simultaneously improved. By 2020, the proportion of green building in urban new buildings exceeds 50%. During the 13th Five-year period, the percentage of two-stars and three-stars green buildings exceeds 80%, the percentage of projects which gain Green Building Operation Label ups to 30%.

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3、Standard System

- The definition, assessment index and assessment method of green building are clarified in the national standard **Assessment Standard for Green Building (GB/T 50378)**.
- GB/T 50378 plays a significant role in promoting the development of green building in China.
- Based on GB/T 50378, standard system of green building in China has formed, and goes towards a refined trend.


UDC

中华人民共和国国家标准

P GB/T 50378-2019

绿色建筑评价标准

Assessment standard for green building

2019-03-13 发布 2019-08-01 实施

中华人民共和国住房和城乡建设部
国家市场监督管理总局 联合发布

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3、Standard System

Green Building Standard System covers the whole building life cycle

Design Stage

- Code for green design of civil buildings(JGJ/T 229)
- Standard for green performance calculation of civil buildings(JGJ/T 449)

Construction Stage

- Evaluation standard for green construction of building(GB/T 50640)
- Code for green construction of building(GB/T 50905)

Operation Stage

- Technical code for operation and maintenance of green building(JGJ/T 391)
- Standard for test and assessment of green lights(GB/T 51268)

Retrofitting Stage

- Assessment standard for green retrofitting of existing building(GB/T 51141)
- Technical standard for green retrofitting of existing community(JGJ/T 425)

Assessment Stage

- Assessment standard for green building (GB/T 50378)
- Assessment standard for green eco-district(GB/T 51255)
- Assessment standard for green campus(GB/T 51356)

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3、Standard System

Assessment standard system covers **new building**, **existing building**, **industry building** and **area**.

- **Green Building Assessment Standard System**
  - **New Building**
    - Assessment standard for green building (GB/T 50378)
    - Evaluation standard for green office building (GB/T 50908)
    - Assessment standard for green store building (GB/T 51100)
    - Evaluation standard for green hospital building (GB/T 51153)
    - Assessment standard for green hotel building (GB/T 51165)
    - Assessment standard for green museum and exhibition building (GB/T 51148)
  - **Existing Building**
    - Assessment standard for green retrofitting of existing building (GB/T 51141)
  - **Industrial Building**
    - Assessment standard for green industrial building (GB/T 50878)
  - **Area**
    - Assessment standard for green eco-district (GB/T 51255)
    - Assessment standard for green campus (GB/T 51356)

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3、Standard System

Local Standards & Group Standards

Local Standards: Different provinces allowed to develop their own standards according to the regional characteristics of cities (climate, economic, development level, etc.).

Group Standards: Academic groups, such as organizations, association and alliance, to be allowed to develop standards to fill the blank of national standards and industry standards.

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4、Introduction of Latest Standard

- **Process: "Three versions & Two Revisions" of GB/T 50378**

First version issued in 2006 | Second version issued in 2014 | Third version issued in 2019

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4、Introduction of Latest Standard

■ Revision Background

➢ **New requirements of 19th CPC National Congress:**

- To meet the people's ever-growing needs for a better life in the new era.

➢ **New demands of green building in new era**

- To follow the new technologies and concepts in building industry
- To innovate green building assessment technology index system
- To meet the high quality development demand of green building

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4、Introduction of Latest Standard

■ Revision Background

➢ **Problems raised in the development process**

- More of Design Labels and less of Operational Labels, lack of the actual effects
- People-oriented requirements are not enough, more requirements are required for the performance of building itself (insulation of wall, materials saving, water saving)
- Poor response to the new technologies and concepts under the fast development of building industry
- Perceptible requirements need to improve to let occupants feel the benefits of green building (health, comfort, quality, etc.)

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4、Introduction of Latest Standard

■ Revision Highlights

(1) Build an innovative assessment technology index system to meet the people's need for a better life

Establish the core of people-oriented and take the wellbeing of the people as the goal

Before (2006 & 2014 version):
Four saving & one environmental protection

- Land Saving
- Energy Saving
- Water Saving
- Material Saving
- Environmental Protection

After (2019 version):
Five performance

安全耐久 Safety and Durability
健康舒适 Health and Comfort
生活便利 Occupancy Convenience
资源节约 Resource Saving
环境宜居 Environment Livabillity

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4、Introduction of Latest Standard

■ Revision Highlights

(1) Build an innovative assessment technology index system to meet the people's need for a better life

Green Building Assessment Index System
(Assessment Standard for Green Building (GB/T 50378-2019))

Safety and Durability	I Safety	II Durability
Health and Comfort	I Indoor Air Quality	II Water Quality	III Sound and Daylighting	IV Indoor Thermal Environment
Occupant Convenience	I Transit and Accessibility	II Service Facility	III Intelligent Operation	IV Property Management
Resources Saving	I Land Saving and Land Utilization	II Energy Saving and Energy Resources Utilization
	III Water Saving and Water Resource Utilization	IV Material Saving and Green Materials
Environment Livability	I Site Ecology and Landscape	II Outdoor Physical Environment

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4、Introduction of Latest Standard

■ Revision Highlights

(2) Change the assessment stage and emphasize the practical effect

□ **2014 version**

Design Assessment: After the review of construction drawing. ----Green Building Design Label.
Operation Assessment: After one year of operation. ----Green Building Label.

□ **2019 version**

Assessment of green building can only be allowed when the building project pass the final acceptance.

The Design Assessment is canceled.

The aim of the change is to promote the implementation of green technologies and improve the practical effect.

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4、Introduction of Latest Standard

■ Revision Highlights

(3) Add green building grade to promote popularization of green buildings

■ **Basic grade**, one - star, two - star, three – star, totally 4 green building grades

- If all the requirements of "Prerequisite Items" are met, it is "Basic grade green building".
- The "Prerequisite Items" will write into the mandatory engineering codes of China so as to promote popularization of green buildings and to achieve the goal of "all the buildings are green ".

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4、Introduction of Latest Standard

■ Revision Highlights

(4) Set four requirements for 1~3 star green building to enhance the green building performance

■ For 1-star, 2-star and 3-star green building:

① Set a lowest score for each index;

② Shall be fully decorated ;

③ Scored 60, 70 and 85 respectively ;

④ Meet the additional requirements in the aspects of building envelope thermal performance, sound insulation performance, water saving efficiency, indoor air quality.

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5、Prospect

■ The contribution of green buildings in the fight against COVID-19

World Green Building Council(WGBC) and the International Union of Architects (UIA) affirm the contribution of GB/T 50378-2019 in the fight against COVID-19:

- Providing the basic functions for epidemic prevention and control
- Providing convenience and facilities for epidemic prevention and control
- Reducing the risk of infection and preventing cross infection
- Promoting and protecting the health of occupants
- Stabilize work and living environment during the epidemic prevention and control

https://www.worldgbc.org/news-media/contribution-green-buildings-fight-against-covid-19
https://covid.uia-architectes.org/covid/chinese-national-standard-assessment-standard-for-green-building/

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5、Prospect

■ Development branch of the green building

- **Healthy China** is one of strategies on China' s development.
- **Healthy Building**, which focuses on the health of the people, is one of the ways to response the Healthy China Strategy, as well as one of the development branchs on the basis of green building.
- ***Assessment standard for healthy building (T/ASC 02)*** **released in 2016.**


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China Academy of Building Research
Thank you !
Guozhu Li
Email: liguozhu50@163.com
PhD, Deputy Director, Associate Professor
China Academy of Building Research

SAARC ENERGY CENTER WEBINAR:

PROMOTING ENERGY EFFICIENT BUILDINGS IN SAARC REGION USING EDGE GREEN BUILDING RATING SYSTEM

23 June 2020

Muhammad Bilal Sajid, PhD
CEM, CEA, LEED GA, EDGE Expert & Auditor, TRUE Advisor
Member AEE, Member (Associate) ASHRAE

United States – Pakistan Center for Advanced Studies in Energy (USPCASE),
National University of Sciences and Technology (NUST),
Islamabad, Pakistan

Scheme of Presentation

1. Sustainability in Buildings
2. Green Building Rating Systems

} 5 minutes

3. Introduction to EDGE
4. Energy Efficiency Features in EDGE
5. EDGE Methodology

} 20 minutes

6. EDGE Projects – Case Studies
7. Steps for EDGE Certification of Projects
8. EDGE Expert & EDGE Auditor Training

} 5 minutes

9. EDGE App Interface } 5 minutes

10. Q & A Session } 05 minutes

Intro	EDGE-Concepts	Case Studies	EDGE-Example	Q & A

4

Green Buildings & Sustainability

Sustainability & Sustainable Buildings (3 Ps)

- **PLANET**
  - Efficient Use of Resources e.g. Energy, Water and lesser GHG emissions
- **PEOPLE**
  - Human Comfort e.g. sufficient lighting , air temp, humidity etc.
- **PROFIT**
  - low utility bills and lower life cycle costs

Intro EDGE-Concepts Case Studies EDGE-Example Q & A

5

Green Building Rating Systems

U.S. GREEN BUILDING COUNCIL USGBC

Excellence In Design For Greater Efficiencies Edge

LIVING BUILDING CHALLENGE

INTERNATIONAL WELL BUILDING INSTITUTE™

BREEAM®

DGNB

green star

CASBEE

GREEN GLOBE

Intro EDGE-Concepts Case Studies EDGE-Example Q & A

6

USGBC / GBCI Rating Systems

LEED
WELL
PEER
GRESB
SITES
EDGE
PARKSMART
TRUE
ICP

Intro | EDGE-Concepts | Case Studies | EDGE-Example | Q & A

7

Scheme of Presentation

1. Sustainability in Buildings
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} 5 minutes

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9. EDGE App Interface } 5 minutes

10. Q & A Session } 05 minutes

Intro | EDGE-Concepts | Case Studies | EDGE-Example | Q & A

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EDGE by IFC, World Bank

A resource efficiency certification system for new and existing buildings in emerging markets.

EDGE software reveals technical solutions for going green and captures capital costs and projected operational savings.

EDGE software can be used by all building professionals.

9

EDGE Markets

EDGE IS AVAILABLE IN MORE THAN 160 COUNTRIES AND GROWING

10

EDGE – An Integrated Approach

Assessment Tool

www.edgebuildings.com

- Free to use
- Simple interface
- Global tool

Global Standard

20% improvement

- Water, energy & embodied energy
- Typical construction practice as baseline

Certification System

Validation

- Certification after Design audit and Construction audit
- Simplified auditing

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EDGE: A Building Design Tool

www.edgebuildings.com

- Localized for utility costs, climate etc.
- Design-specific results using building physics calculations
- Design Guidance on multiple technical measures
- Investment planning for building owners

Intro | EDGE-Concepts | Case Studies | EDGE-Example | Q & A

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EDGE Standard

'A building that has **20% less energy, water and material consumption** compared to an equivalent local benchmark.

EDGE Advance: 40% Savings in Energy (by Energy Efficiency)

EDGE Zero Carbon: EDGE Advance + Onsite / Offsite RE + Carbon Offset

Intro | EDGE-Concepts | Case Studies | EDGE-Example | Q & A

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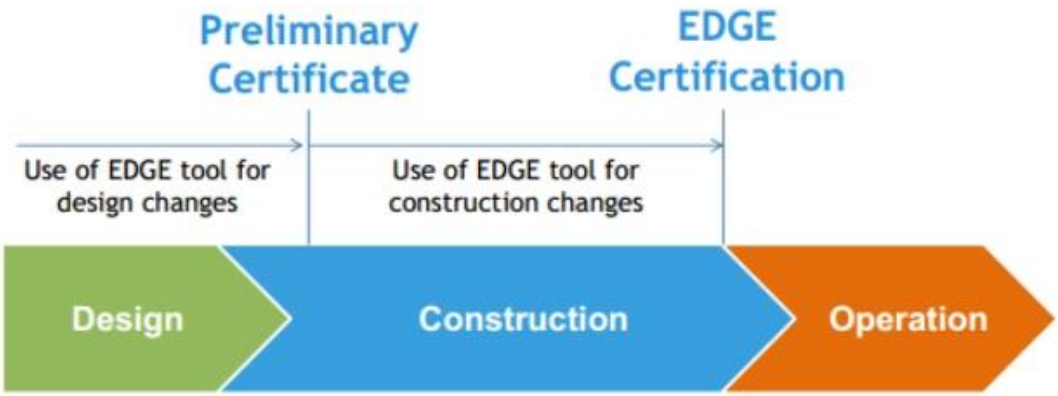
EDGE Certification Cycle



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EDGE Projects Types

- Conditioned (heated or cooled) or naturally ventilated structure
- 1 or more FTE occupant
- At least 200 SQM (50 SQM minimum for single family homes)

✓ New construction
✓ Core and Shell

✓ Retrofits
✓ Existing Buildings

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Unique Benefits of Learning EDGE

- Fundamentals of Green Buildings
- Free of Cost Resources
- Most Suitable Rating System for Developing Countries
- Gaining experience with GBCI family of certifications
- Internationally Recognized Professional Credentials
  - EDGE Expert
  - EDGE Auditor
- Expanding expertise to other Rating Systems
  - LEED
  - Living Building Challenge
  - BREEM
  - WELL
  - DGNB

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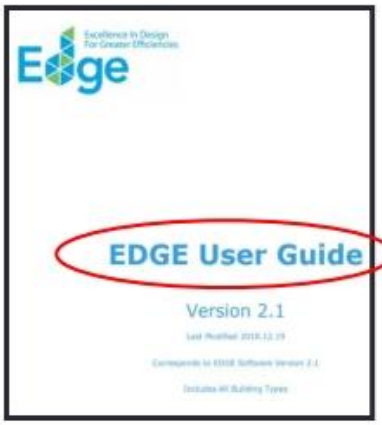
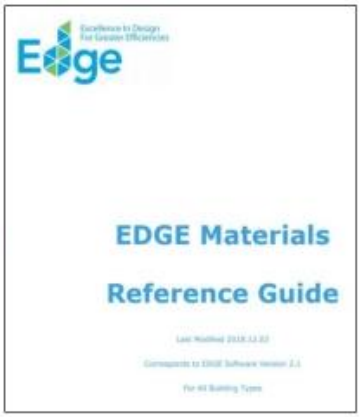
EDGE Primary Resources



288 Pages



160 Pages

10 Pages

Intro EDGE-Concepts Case Studies EDGE-Example Q & A

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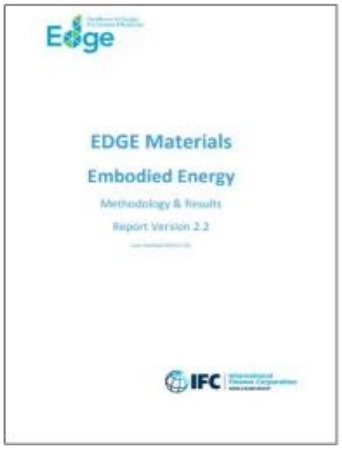
EDGE Reference Resources

100 Pages



42 Pages

15 Pages

Intro EDGE-Concepts Case Studies EDGE-Example Q & A

Energy Efficiency Measures in EDGE

A. Building Envelope
B. HVAC
C. Water Heating
D. Lighting / Misc.
E. Renewable Energy

Energy Efficiency Measures in EDGE Building Envelope

1. Reduced Window to Wall Ratio
2. External Shading Devices

3. Reflective Paint / Tiles for Roof
4. Reflective Paint for External Walls

5. Insulation of Roof
6. Insulation of External Walls

7. Low-E-Coated Glass
8. High Thermal Performance Glass

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Energy Efficiency Measures in EDGE HVAC

9. Natural Ventilation
10. Ceiling Fans
11. Air Conditioning System
12. Air Conditioning with Air Cooled Chiller
13. Air Conditioning with Water Cooled Chiller
14. VRF Cooling System

15. Absorption Chiller Powered by Waste Heat
16. Air Economizer During Favorable Outdoor Conditioner

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Energy Efficiency Measures in EDGE HVAC

17. CO2 Sensor / Controlled Ventilation for Fresh Air Intake
18. Earth Air Tunnel System to Pre-Cond Supply Air Intake

19. Variable Speed Drives on the Fans on Cooling Towers
20. VSF or VFD in AHUs
21. Variable Speed Drive Pumps

22. Ground Source Heat Pumps
23. Radiant Heating and Cooling System
24. Sensible Heat Recovery from Exhaust Air

22

Energy Efficiency Measures in EDGE Water Heating

25. High Efficiency Condensing Boiler for water Heating
26. Recovery of Waste Heat from Generator for water Heating
27. High Efficiency Boiler for Water Heating
28. Heat Pump for Hot Water

29. Preheat Water Using Waste Heat from the Generator
30. Heat Recovery from Grey Water
31. Heat Recovery from Laundry Waste Water

23

Energy Efficiency Measures in EDGE Lighting / Misc.

32. Energy Saving Light Bulbs
33. Lighting Controls
34. Skylight(s) to Provide Daylight to 50% of Top Floor Area

35. Variable Speed Hoods with Automated Fan Controls
36. Energy Efficient Refrig. and Clothes Washing Machines
37. Higher Efficiency Refrigerated Cases
38. Smart Meters

24

Energy Efficiency Measures in EDGE Renewable Energy

39. Solar Hot Water Collectors
40. Solar Photovoltaics
41. Other Renewable Energy for Electricity Generation
42. Offsite Renewable Energy Procurement
43. Carbon Offset

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EDGE – Water Efficiency

1. Low Flow Showerheads
2. Low Flow Faucets for Washbasins
3. Water Efficient Water Closets
4. Water Efficient Urinals
5. Water Efficient Kitchen Faucets
6. Low Flow Pre-Rinse Spray Valves for Dishwasher
7. Water Efficient Dishwashers
8. Water Efficient Front-Loading Washing Machines
9. Laundry Rinse Water Reclamation System
10. Condensate Water Recovery System
11. Water Efficient Landscaping

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EDGE – Water Efficiency

12. Swimming Pool Cover
13. Rainwater Harvesting System
14. Grey Water Treatment and Recycling System
15. Black Water Treatment and Recycling System

EDGE – Embodied Energy / Materials

1. Floor Slabs
2. Roof Construction
3. External Walls
4. Internal Walls
5. Flooring
6. Window Frames
7. Insulation
8. Insulation

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EDGE Methodology

EDGE calculations are based on the following:

1. Climatic conditions of the location
   - Monthly average wet and dry bulb temperature
   - Monthly average outdoor wind velocity
   - Monthly average outdoor humidity
   - Solar radiation intensity
   - Annual average rainfall
   - Carbon dioxide intensity of the electricity grid
   - Average cost of energy (by fuel type) and water
2. Building type and occupant use (refer to Methodology Report)
3. Design and specifications
   - Base Case vs. Improved Case
   - Baseline Assumptions

Intro EDGE-Concepts Case Studies EDGE-Example Q & A

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Scheme of Presentation

1. Sustainability in Buildings
2. Green Building Rating Systems

} 5 minutes

3. Introduction to EDGE
4. Energy Efficiency Features in EDGE
5. EDGE Methodology

} 20 minutes

6. EDGE Projects – Case Studies
7. Steps for EDGE Certification of Projects
8. EDGE Expert & EDGE Auditor Training

} 5 minutes

9. EDGE App Interface } 5 minutes

10. Q & A Session } 05 minutes

Intro EDGE-Concepts Case Studies EDGE-Example Q & A

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Greenox Residence, Istanbul, Turkey

Water
- Low-flow showerheads
- low-flow faucets for kitchens and bathrooms
- dual-flush water closets.

Materials
- Concrete filler slabs for floors and roofs and
- cored bricks with plaster on both sides for internal and external walls.

35% Energy Savings*

42% Water Savings

41% Less Embodied Energy in Materials

Energy
- Reduced window to wall ratio
- Reflective paint for external walls
- Insulated roof and external walls
- Low-E coated glass
- Variable refrigerant volume (VRV) cooling system
- High-efficiency boilers for heating and hot water
- Energy-saving lighting and lighting controls for common areas and outdoors.

Intro | EDGE-Concepts | Case Studies | EDGE-Example | Q & A

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FINSA office, Aguascalientes, New Mexico

Water
- Dual-flush water closets
- Low-flow faucets in bathrooms
- Water-efficient faucets for kitchen sinks.

Materials
- In-situ reinforced concrete for the floor
- concrete filler slab with polystyrene blocks for the roof
- Cored bricks with plaster for internal and external walls
- Precast concrete panels for external walls,
- Finished concrete and nylon carpets for the flooring.

45% Energy Savings*

35% Water Savings

52% Less Embodied Energy in Materials

Energy
- Reduced window to wall ratio
- Reflective paint/tiles for the roof
- External shading devices
- Low-E coated glass, a variable
- Refrigerant volume (VRV) cooling system
- Energy-saving lighting in internal and external spaces
- Occupancy sensors in bathrooms
- Conference rooms and closed cabins.

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EDGE Expert & EDGE Auditor Training

- EDGE Expert Training (GBCI & ThinkStep-SGS)
  - Fee: 150USD
  - On-Demand videos (recorded)
  - Live stream, Online
  - Face to Face, In-person
- EDGE Expert Exam (Prometric Exam Center)
  - Optional Practice Exam (30 USD)
  - Online Exam (100 USD)
- EDGE Auditor Training (399 USD, 150 USD annual)
- Separate for both GBCI & ThinkStep-SGS
- EDGE Expert & EDGE Auditor credentials: Valid Worldwide

Intro EDGE-Concepts Case Studies EDGE-Example Q & A

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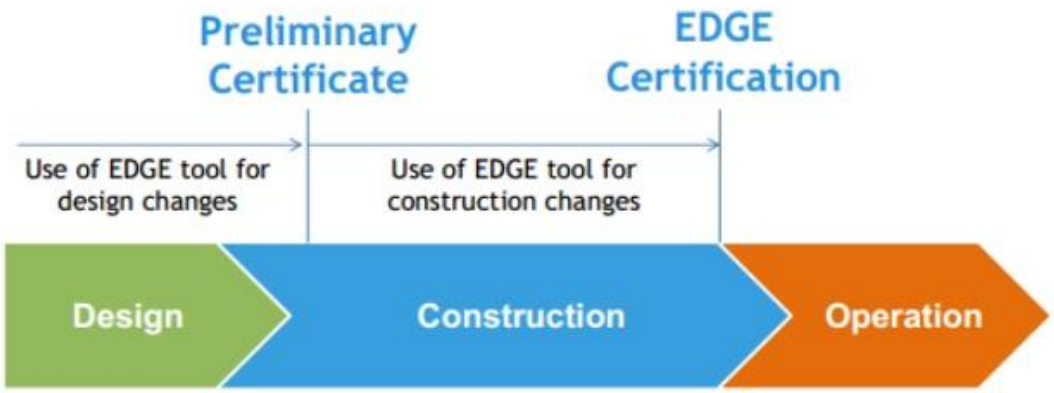
Steps for EDGE Certification of Projects



Intro EDGE-Concepts Case Studies EDGE-Example Q & A

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} 5 minutes

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} 5 minutes

9. EDGE App Interface } 5 minutes

10. Q & A Session } 05 minutes

Intro | EDGE-Concepts | Case Studies | EDGE-Example | Q & A

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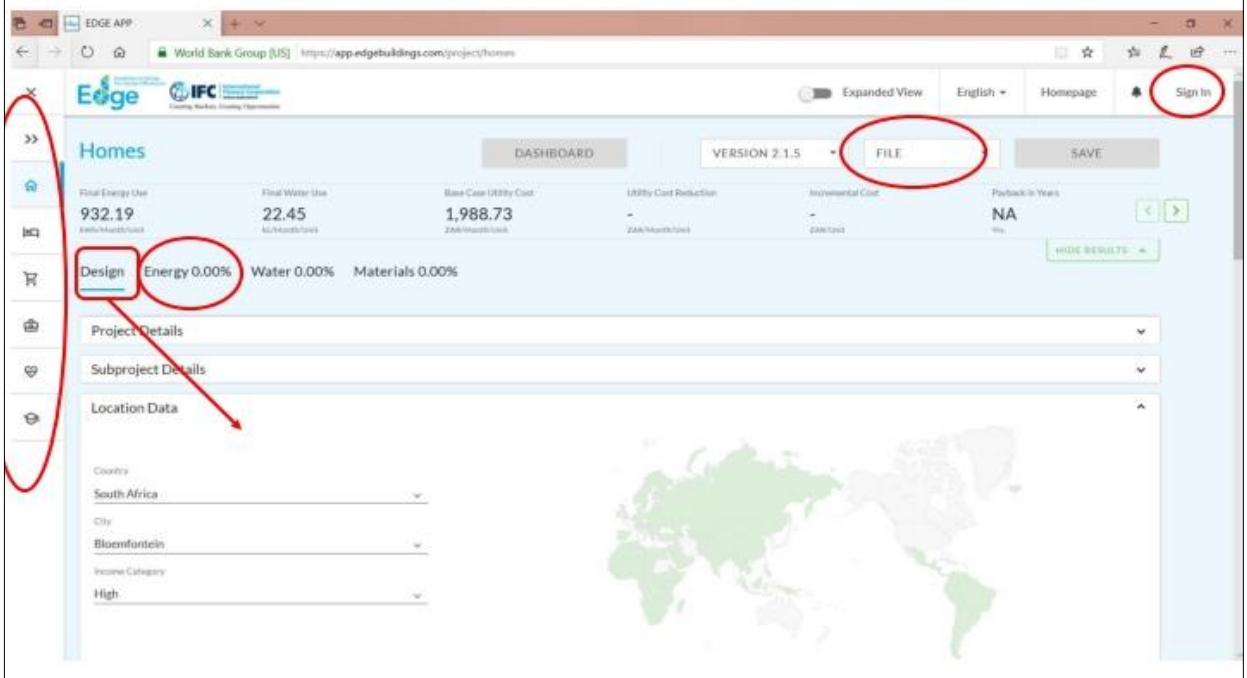

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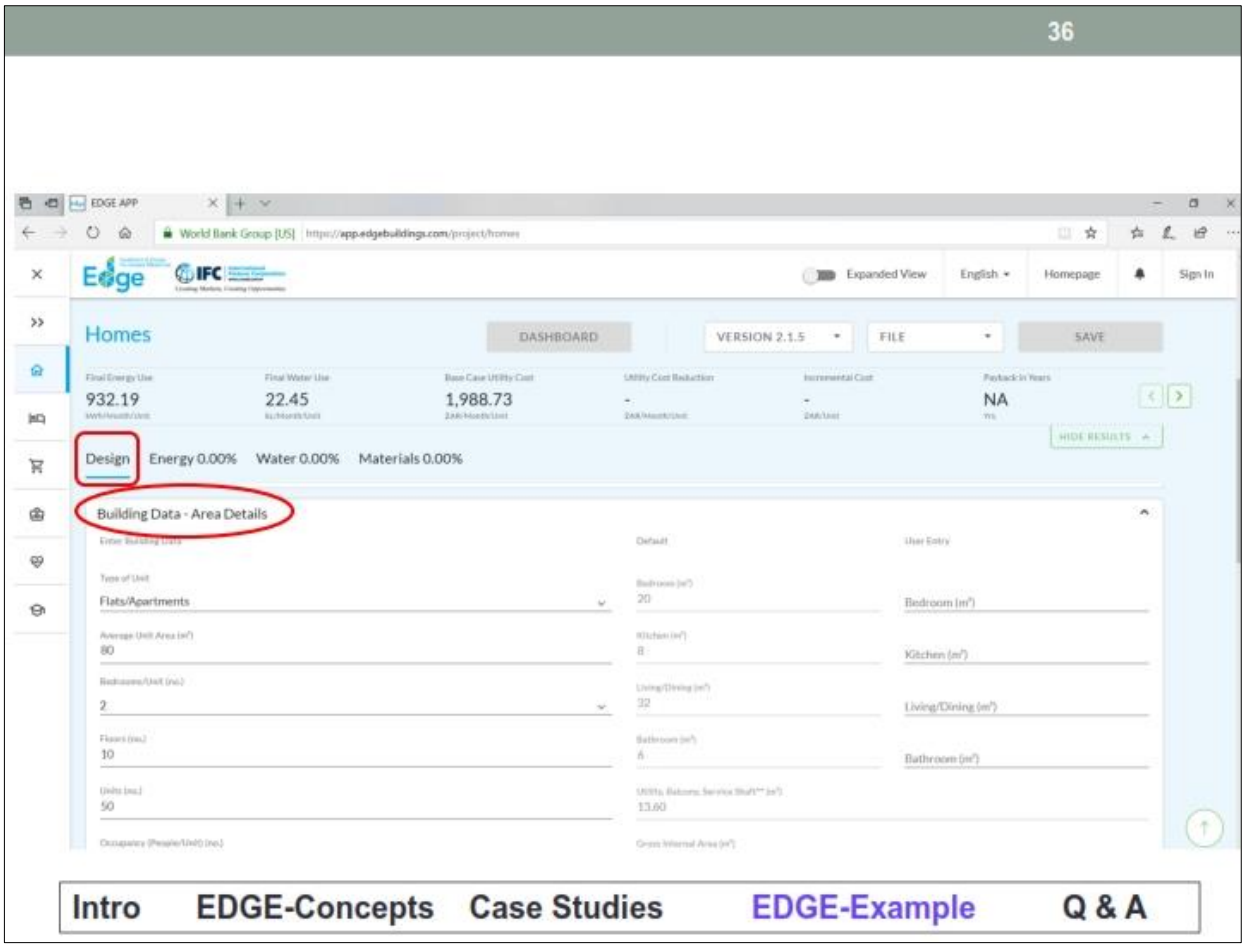
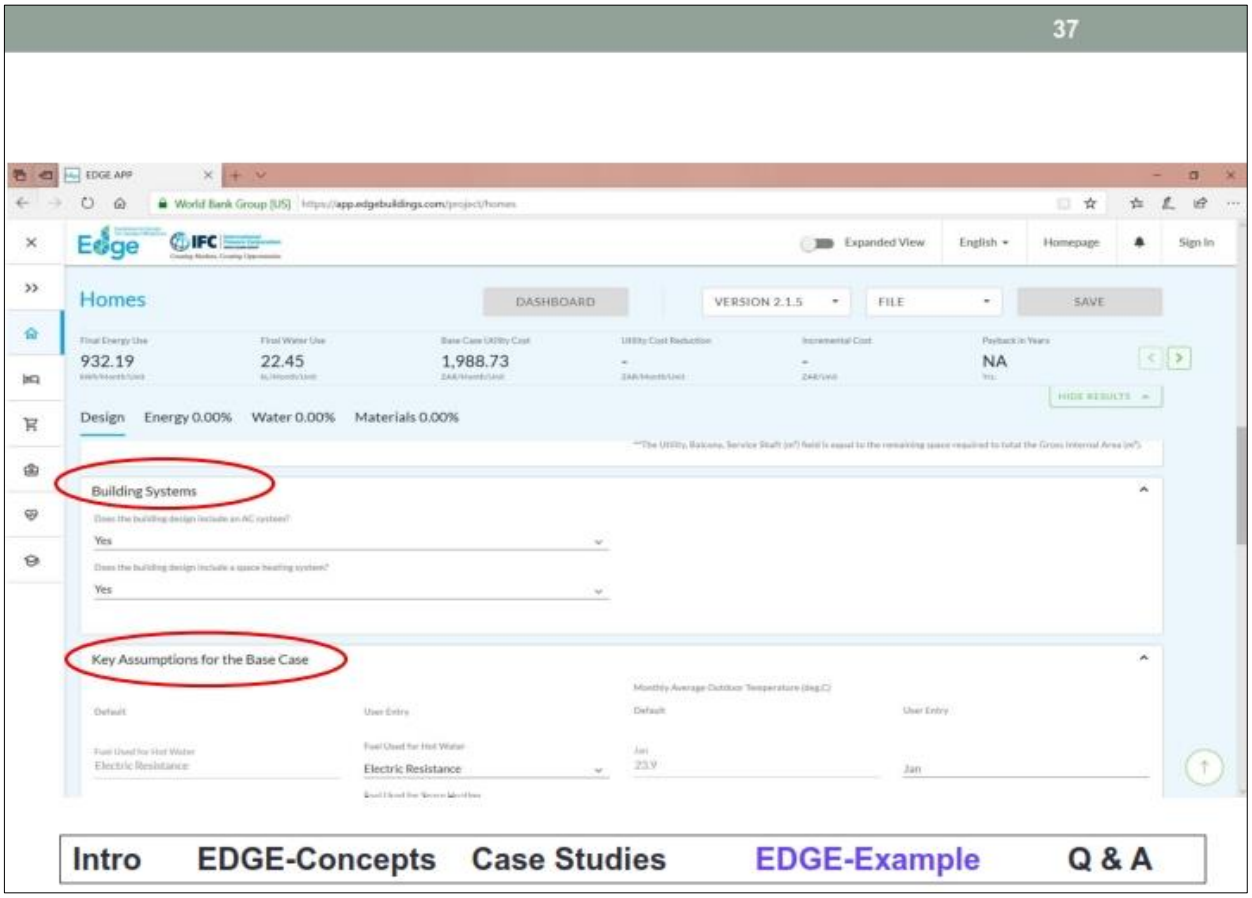

36
EDGE APP
World Bank Group [US]
Expanded View
English
Homepage
Sign In
Homes
DASHBOARD
VERSION 2.1.5
FILE
SAVE
932.19
22.45
1,988.73
NA
Design
Energy 0.00%
Water 0.00%
Materials 0.00%
Building Data - Area Details
Flats/Apartments
Intro
EDGE-Concepts
Case Studies
EDGE-Example
Q & A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World Bank Group [US]
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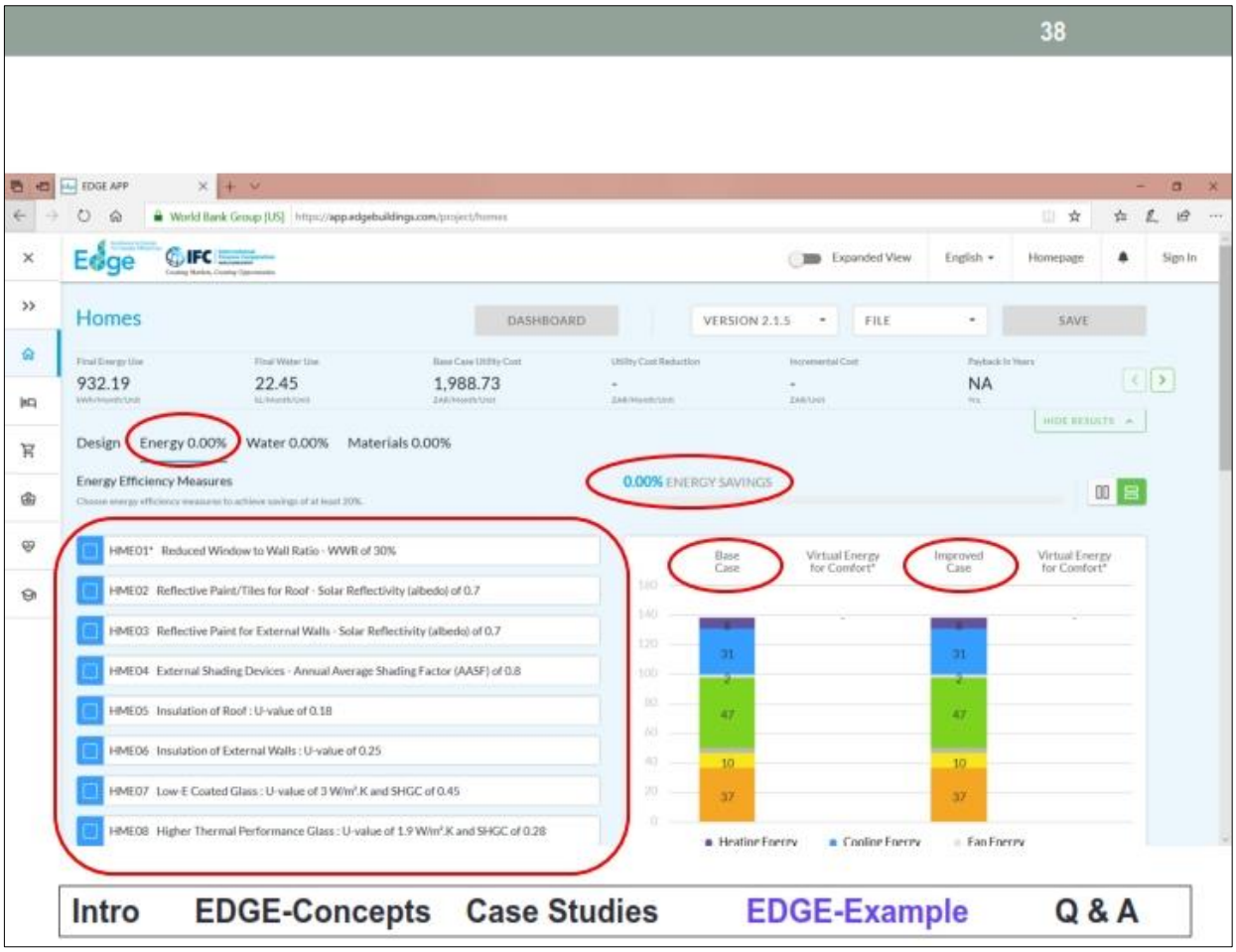
Homes
DASHBOARD
VERSION 2.1.5
FILE
SAVE
932.19
22.45
1,988.73
NA
Design
Energy 0.00%
Water 0.00%
Materials 0.00%
Building Systems
Key Assumptions for the Base Case
Electric Resistance
Intro
EDGE-Concepts
Case Studies
EDGE-Example
Q & A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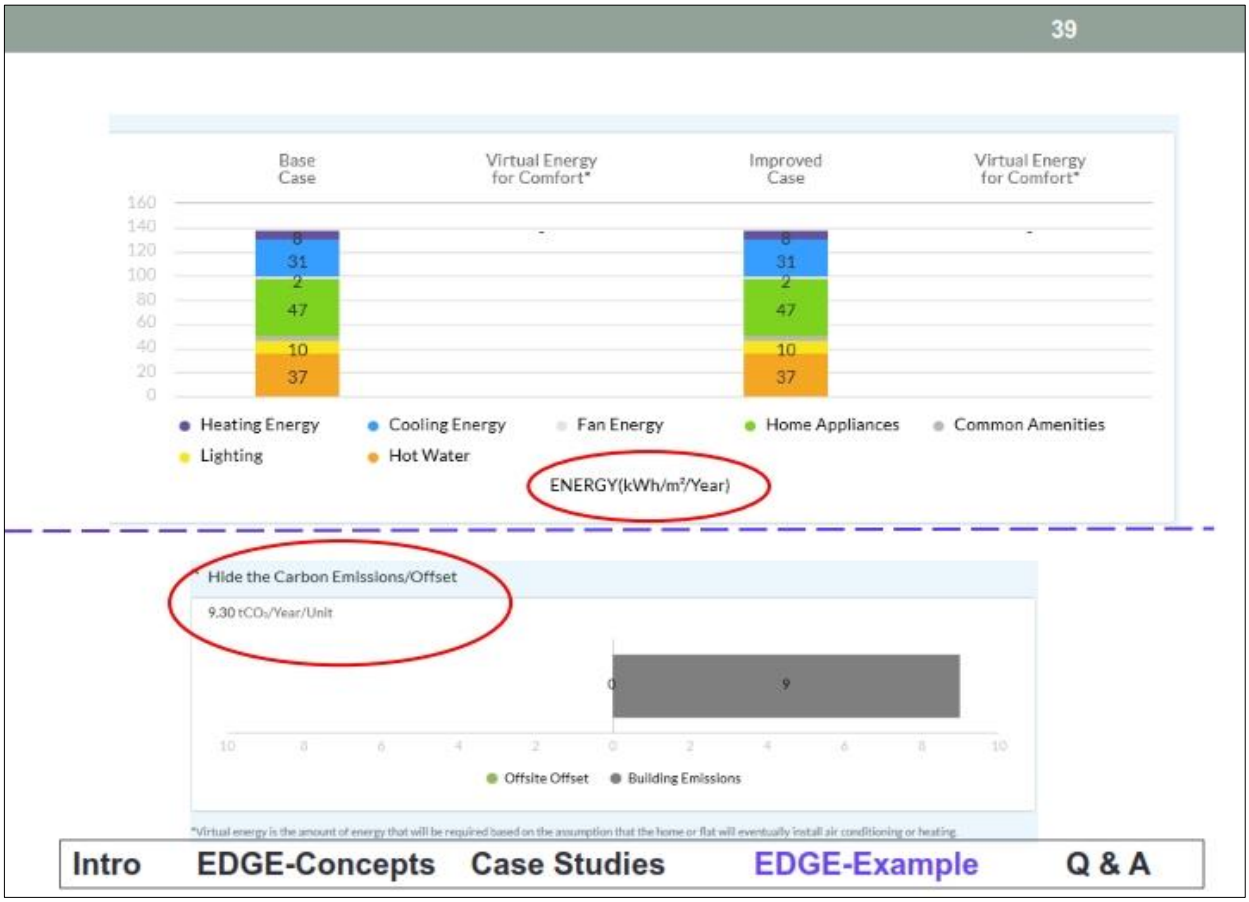
VERSION 2.1.5
FILE
SAVE
932.19
22.45
1,988.73
NA
Design
Energy 0.00%
Water 0.00%
Materials 0.00%
Energy Efficiency Measures
0.00% ENERGY SAVINGS
HME01* Reduced Window to Wall Ratio - WWR of 30%
HME02 Reflective Paint/Tiles for Roof - Solar Reflectivity (albedo) of 0.7
HME03 Reflective Paint for External Walls - Solar Reflectivity (albedo) of 0.7
HME04 External Shading Devices - Annual Average Shading Factor (AASF) of 0.8
HME05 Insulation of Roof : U-value of 0.18
HME06 Insulation of External Walls : U-value of 0.25
HME07 Low-E Coated Glass : U-value of 3 W/m².K and SHGC of 0.45
HME08 Higher Thermal Performance Glass : U-value of 1.9 W/m².K and SHGC of 0.28
Base Case
Virtual Energy for Comfort*
Improved Case
Virtual Energy for Comfort*
Intro
EDGE-Concepts
Case Studies
EDGE-Example
Q & A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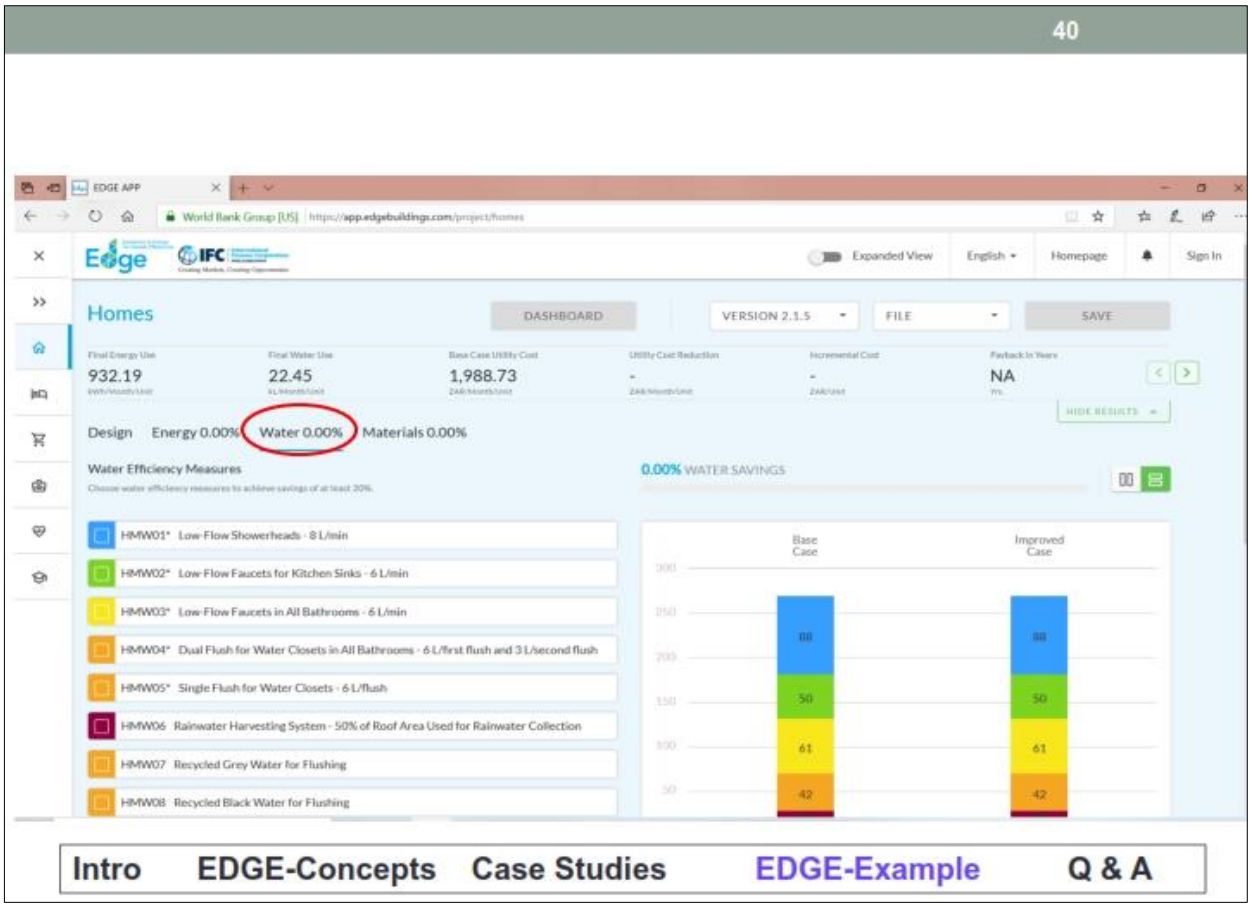
Base Case
Virtual Energy for Comfort*
Improved Case
Virtual Energy for Comfort*
Heating Energy
Cooling Energy
Fan Energy
Home Appliances
Common Amenities
Lighting
Hot Water
ENERGY(kWh/m²/Year)
Hide the Carbon Emissions/Offset
9.30 tCO₂/Year/Unit
Offsite Offset
Building Emissions
*Virtual energy is the amount of energy that will be required based on the assumption that the home or flat will eventually install air conditioning or heating
Intro
EDGE-Concepts
Case Studies
EDGE-Example
Q & A


40
EDGE APP
Homes
DASHBOARD
VERSION 2.1.5
FILE
SAVE
932.19
22.45
1,988.73
NA
Design
Energy 0.00%
Water 0.00%
Materials 0.00%
Water Efficiency Measures
0.00% WATER SAVINGS
HMW01* Low-Flow Showerheads - 8 L/min
HMW02* Low-Flow Faucets for Kitchen Sinks - 6 L/min
HMW03* Low-Flow Faucets in All Bathrooms - 6 L/min
HMW04* Dual Flush for Water Closets in All Bathrooms - 6 L/first flush and 3 L/second flush
HMW05* Single Flush for Water Closets - 6 L/flush
HMW06 Rainwater Harvesting System - 50% of Roof Area Used for Rainwater Collection
HMW07 Recycled Grey Water for Flushing
HMW08 Recycled Black Water for Flushing
Base Case
Improved Case
88
50
61
42
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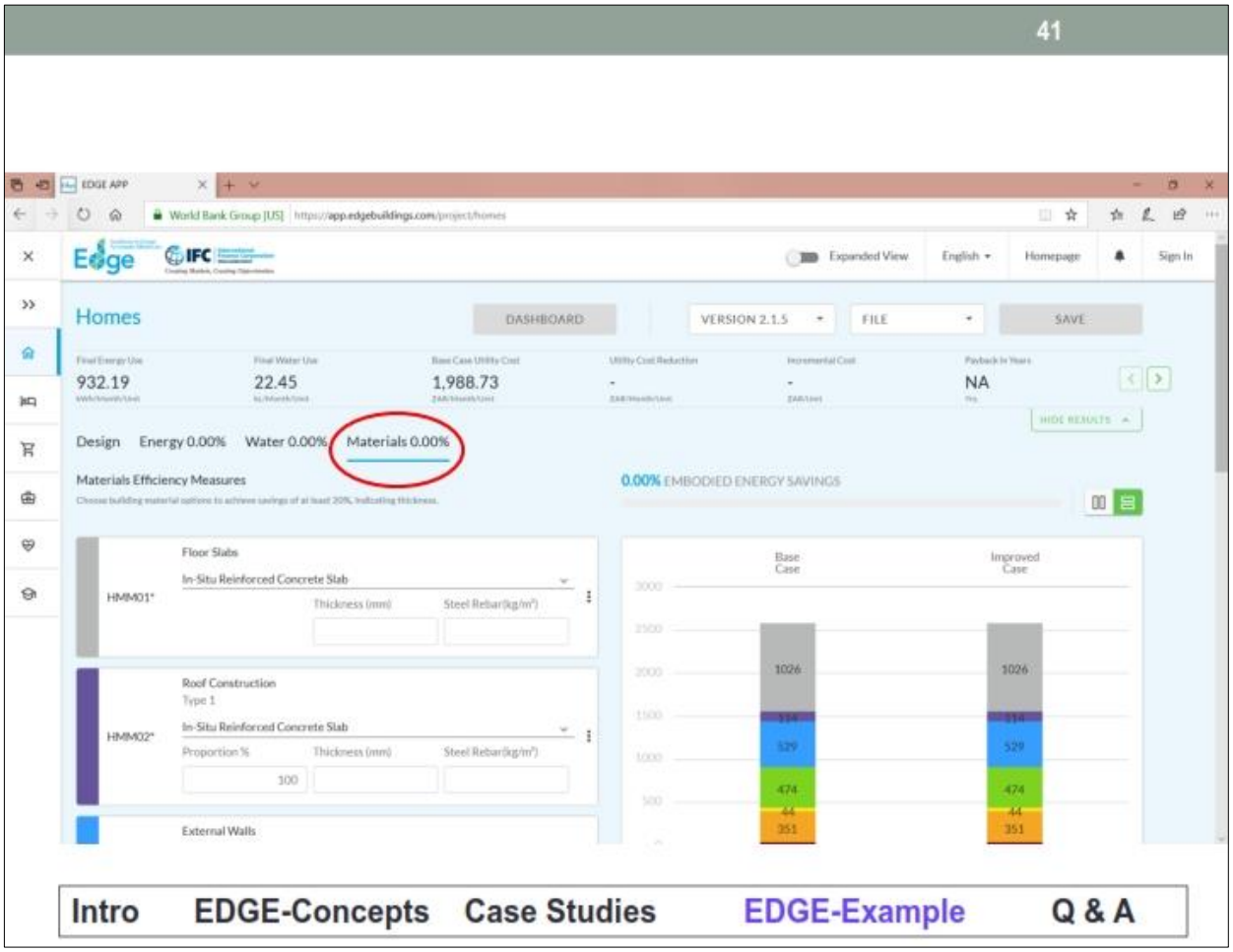
EDGE-Example
Q & A


41
EDGE APP
Homes
DASHBOARD
VERSION 2.1.5
FILE
SAVE
932.19
22.45
1,988.73
NA
Design
Energy 0.00%
Water 0.00%
Materials 0.00%
Materials Efficiency Measures
0.00% EMBODIED ENERGY SAVINGS
Floor Slabs
In-Situ Reinforced Concrete Slab
Thickness (mm)
Steel Rebar(kg/m³)
HMM01*
Roof Construction
Type 1
In-Situ Reinforced Concrete Slab
Proportion %
Thickness (mm)
Steel Rebar(kg/m³)
HMM02*
External Walls
Base Case
Improved Case
1026
529
474
44
351
Intro
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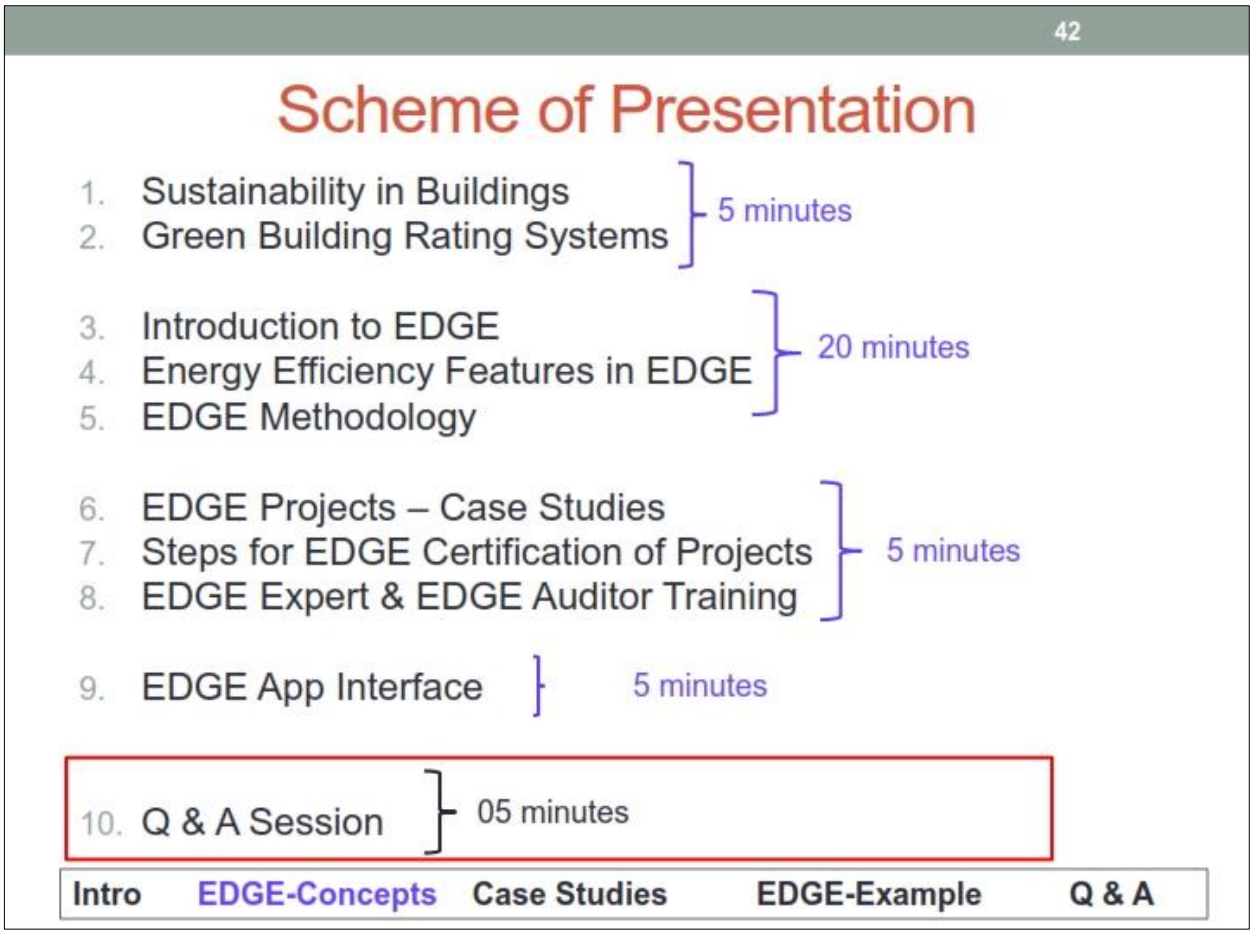
Q & A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Scheme of Presentation
1. Sustainability in Buildings
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5 minutes
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