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Going Global Partnerships

Sustainable Human to Building Behavioural Interaction: Awareness Development Roadmap and Training Programme: SusHumBuild

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Session 1 – outline (BUE)

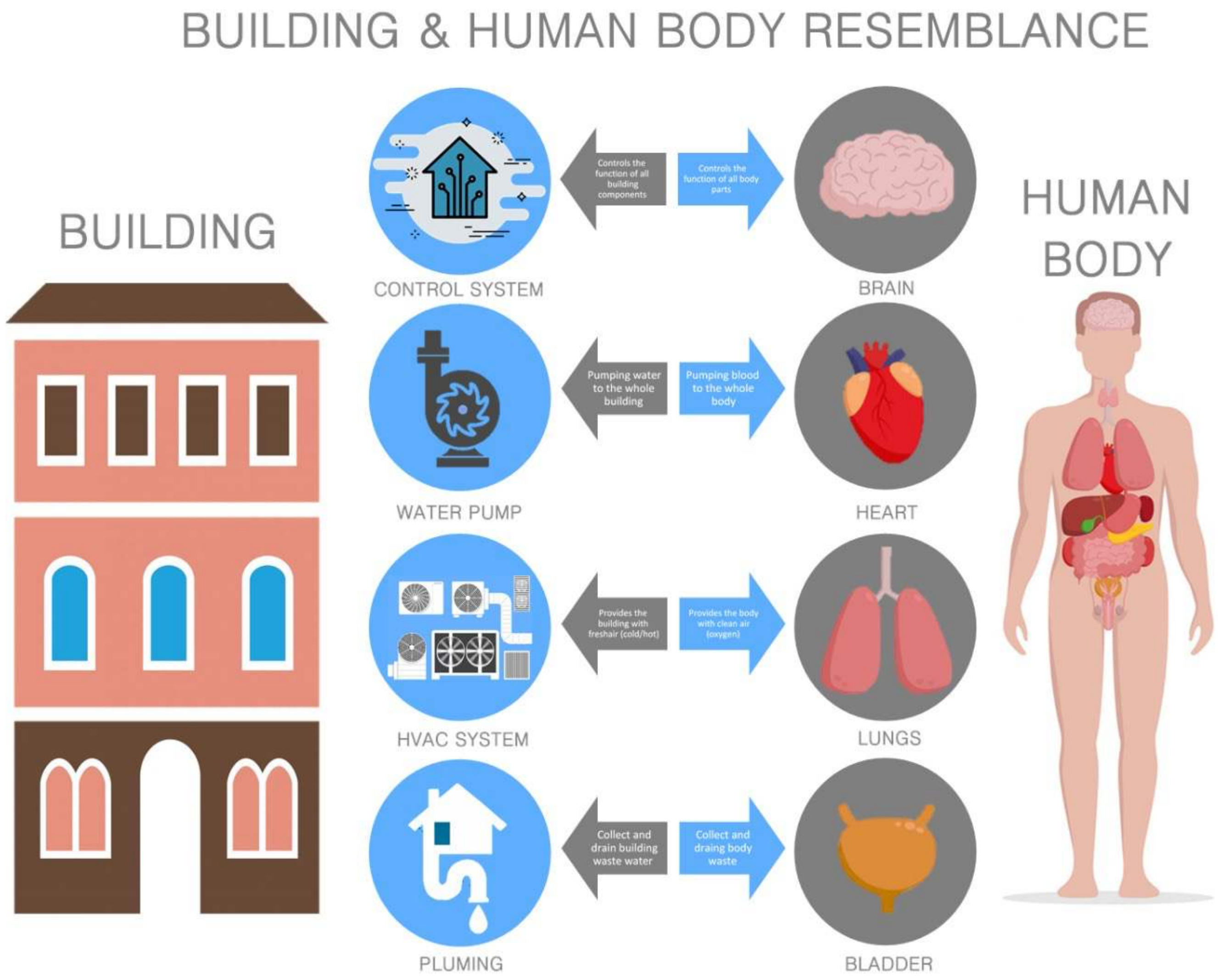
Welcome

Building anatomy

Literature and background

Project importance

Building anatomy



Literature and background

Contents list available at IJRED website
Int. Journal of Renewable Energy Development (IJRED)
Journal homepage: https://ijred.undip.ac.id
Research Article

Investigating the Environmental and the Energy Saving Behavior among School Principals through Classification Algorithms

Stamatios Ntanos[a], Grigorios L. Kyriakopoulos[b,*], Theodoros Anagnostopoulos[c], Theodoros Xanthopoulos[c], Christos Kytagias[c], Dimitrios Drosos[a]

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[b]*School of Electrical and Computer Engineering, Electric Power Division, Photometry Laboratory, National Technical University of Athens, 15780 Athens, Greece.*
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Education is the second-largest consumer of energy in the service sector. School buildings are significant points of energy consumption. In the European Union (EU) context, buildings alone are responsible for 40% of total energy consumption, 60% of electricity consumption and 36% of greenhouse gas emissions. While new buildings generally require less than 3-5 lt/m^2/year of heating oil, older buildings require an average of 25 lt/year. Some energy-intensive buildings require even 60 litres/m^2/year. 35% of EU buildings are over 50 years old (Doukas *et al.*, 2017). Similarly, in the United States, the ASHRAE's Building Energy Quotient (bEQ) program is an eco-

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This paper focuses on the role of the school unit principal as a decision-maker concerning energy-saving action by exploring the environmental perceptions and energy-saving behaviour and unveiling what motivates the application of energy upgrading and the positive environmental perceptions.

More specifically, the objective of this research is to locate the most important predictive variables that are associated with each of the five following statements:

- The importance of providing RES oriented education in schools.
- The teachers' role towards energy saving at the school environment.
- The students' role towards energy saving at the school environment.
- The teachers' role in raising awareness on RES.
- The use of energy upgrading and energy-saving actions at school.

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Improving energy efficiency in buildings is one of the top priorities worldwide. However, little research has focused on linking education policies and energy demand. Therefore, in exploring the role of energy policies in education, researchers need to determine those factors that drive energy policies. To this end, various measures are available, and the decision-maker faces a multi-objective decision problem that must be offset by deciding about energy, finance, and other factors to make a good choice. (Diakaki *et al.*, 2013).

School buildings are significant to society since these represent a significant part of the building stock, and the number of children attending schools is immense. There are more than 100 million in Europe. However, in the design of school buildings, obtaining the proper environment is often not considered a priority. Existing school buildings are often lacking systems that optimize energy consumption. In recent decades, several educational buildings have been built with respect for environmental protection and rational energy use (Zeiler and Boxem, 2013).

Literature and background

Renewable and Sustainable Energy Reviews 40 (2014) 911–922

Contents lists available at ScienceDirect

Renewable and Sustainable Energy Reviews

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Energy consumption in schools – A review paper

CrossMark

Luísa Dias Pereira [a,*], Daniela Raimondo [b], Stefano Paolo Corgnati [b], Manuel Gameiro da Silva [a]

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Most of the times, the available data on buildings' energy consumption corresponds to the type of (primary) energy delivered to the building. Ideally, the total amount of energy consumption in buildings should be disaggregated by the final energy end-use (consumptions). Disaggregating energy data helps knowing where most energy is used. In the USA, "for schools in general, lighting, ventilation, heating, and cooling account for 80% of energy consumption"; Fig. 1, based on data available at [51], illustrates this scenario. The importance of this theme is later developed in Section 5.

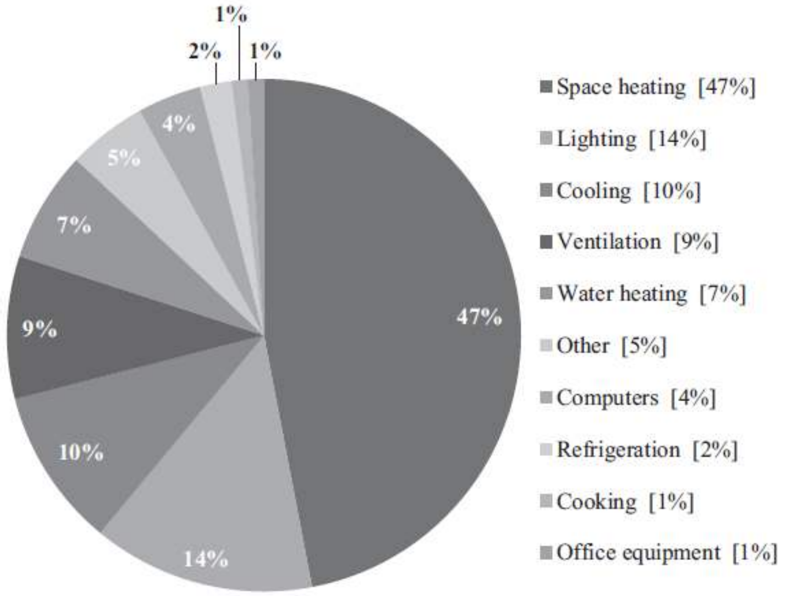

Fig. 1. Average energy use profile of schools in the USA.

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Energy consumption in schools – A review paper

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Among all public buildings, on account of their educational purpose, school buildings have a major social responsibility. Therefore energy performance in this type of building is of great importance, together with suitable levels of Indoor Environmental Quality (IEQ). Following the Energy Performance of Buildings Directive, at a European level, the MS propose different Energy Performance Certificates (EPC) exhibiting different information at distinct scales, namely continuous and stepped. A similar process has been taking place in the US and in Canada.

According to [15], circa 30% of the European MS "have experience with measured energy used for national/regional energy performance evaluation". On the other hand, most of EPC procedures are based on simulation/calculation methods and not necessarily on operational rating (OR). This means that no direct relation can be established between buildings' energy labeling and benchmarking. This idea was first defended by the authors in [16].

EPCs in public buildings, particularly in schools, could drive into energy benchmark hypothesis (for heating and electricity needs), based upon reference building types, driven, on their turn, from average/typical consumption values or good practice [17].

Through benchmarking, school facility managers can compare their school to how much energy a typical elementary, middle and high school in a specific geographic region should consume, assuming the same target Indoor Climate Conditions (ICC). Throughout benchmarking, substantial energy cost savings could be generated while improving the ICC of school facilities. In resume, it is a fundamental method to be implemented.

The information about the different sources that were considered for the literature review is summarized in Table 1.

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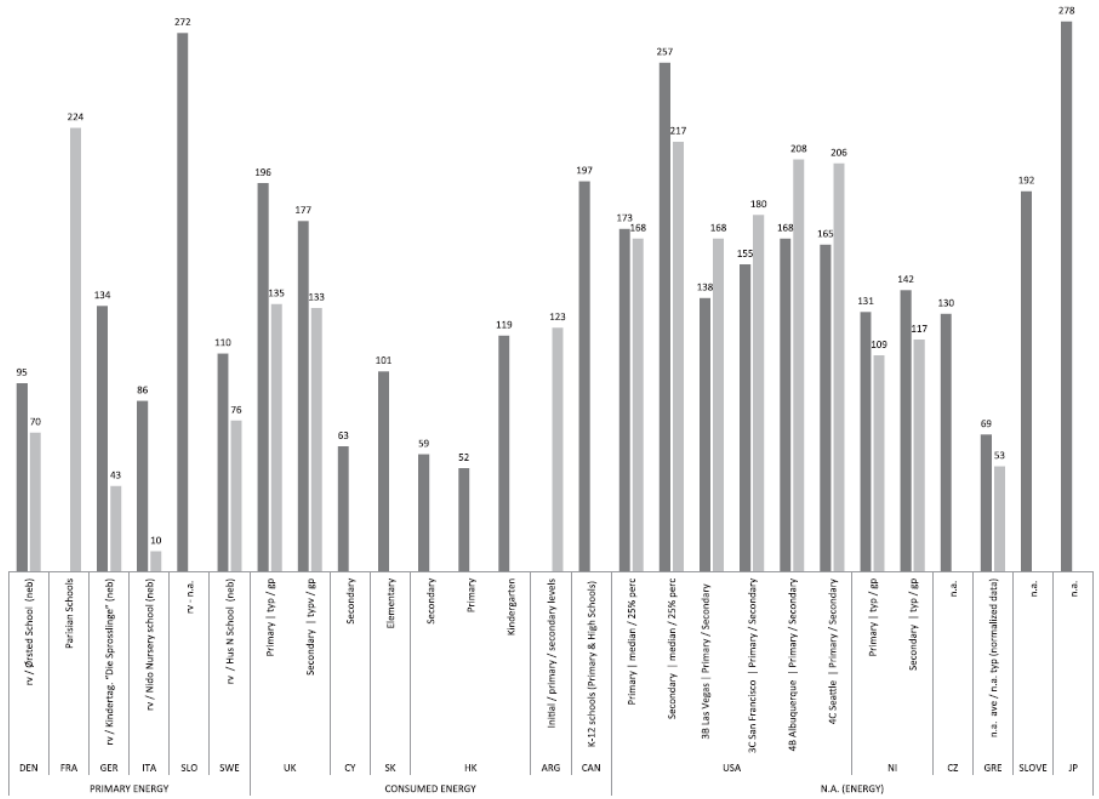
The values found in the literature for Finnish schools [22], particularly in the Helsinki area, are presented both for *district heating energy use* and for the *total electrical energy use*. The values presented in Fig. 2 correspond to the sum of both and were determined by the authors.

Butala and Novak [36] presented the results of energy audits performed in 24 old school buildings in Slovenia, built between 1874–1969 and adapted between 1948–1996. Here, the average total energy values (heating, DHW, lighting) are expressed both in *square meter of building area* and in *per unit of volume of building*, 192 kWh/m^2 per year and 54 kWh/m^3 per year, respectively. The authors reinforce however that these values fall outside the range of accepted values of the Slovenian codes for energy use. On this paper, the authors provided also another indicator – heating energy per student, whose average value presented is 1646 kWh/pupil a.

In a recent publication [19], the annual energy consumption value presented for Cyprus schools, based on billed energy, is



Notes: DEN = Denmark; FRA = France; GER = Germany; ITA = Italy; SLO = Slovakia; SWE = Sweden; UK = United Kingdom; CY = Cyprus; HK = Hong Kong; ARG = Argentina; CAN = Canada; USA = United States of America; NI = Northern Ireland; CZ = Czech Republic; GRE = Greece; SK = South Korea; SLOVE = Slovenia; JP = Japan; rv = reference value; n.a.= non availabe (type of school building); EB = educational buildings; gp = good practice; typ = typical.

Fig. 2. Schools' annual global energy consumption values per country (kWh/m^2).

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Evaluation of Sustainable Education Buildings on Samples

Hatice Derya Arslan(✉) and Esin Gülseker

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2.1 Sustainability

Sustainability is derived from latin "subtenir" root, which means "conservation" [1]. Operability continuation of society, ecosystem or any system having continuity until further future by preventing depletion of primary sources can be described as sustainability [2]. In other saying, sustainability is to keep alive and maintain without endangering posterity peace and health with holistic view of current economic and social needs [3]. In general manner, it can be interpreted as making the energy using in structures more productive, supervising of structural wastes, warming of buildings without losing comfort conditions according to the changing climate circumstances.

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Evaluation of Sustainable Education Buildings on Samples

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4.2 Gando Primary School

A new primary school, intended to accommodate 280 pupils from the village and the surrounding areas, was built in the village of Gando in Burkina Faso. Gando Primary school was designed by taking into consideration of climate conditions of area. Constructions are located on the subtropical climate area. Its architect is Diébédo Francis Kéré. Construction was designed in 1999. It was implemented a traditional design on the structure design. A simple form of the object, based on a rectangular plan is made of compressed earth blocks a material characteristic of the region, which serves as an excellent heat insulating barrier between the interior of the object and the external space. The building is characterized by a narrow and elongated shape, and the classes inside, thanks to the window openings, are aired throughout.

(a) (b)

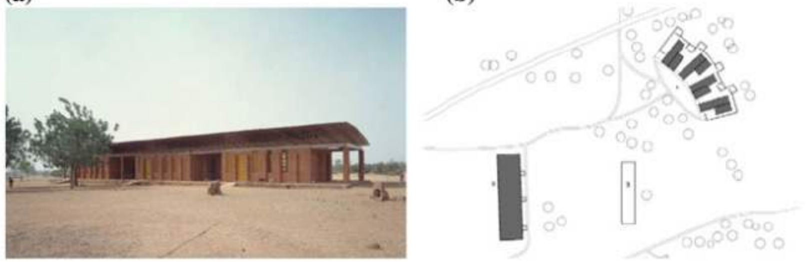

Fig. 4. **a** General view of Gando Primary School [15], **b** master plan of Gando Primary School [15]

The "Primary School for the Village of Gando" project was born of sheer necessity. Given in Fig. 4a, b. The overall School Project comprises of a school complex for 360 pupils, housing for six teachers and their families, sanitary facilities (a dry toilette), a vegetable garden with its own irrigation system, and a school kitchen. The whole Project is so designed that it can be implemented in successive stages. The structure of the building is of traditional clay-building techniques. Site area is about 30,000 m^2 and building area is 526 m^2. The building height is 7.42 m. The materials used in the building are Circular beam (concrete), Supporting clay walls, Reinforcing elements (adobe brickwork), Steel lamella elements in walls, Corrugated metal sheeting in roof and industrial cement (basic structure), stone and poured concrete (foundation), clay bricks in structures, Rampe (natural stone & cast-in-place concrete), Edge strips terrace (natural stone masonery), Terrace covering (hexagonal adobe) in outside areas.

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Energy consumption in Greek school buildings as a function of the climate zone

Sofia Giannarou

2022, IOP Conference Series Earth and Environmental Science 1123(1):012046

Energy Consumption, School Building Design

https://doi.org/10.1088/1755-1315/1123/1/012046

Publication Date: 2022

Publication Name: IOP Conference Series Earth and Environmental Science 1123(1):012046

In this study, the condition of school buildings throughout the Greek territory was analysed, with reference to the typology of the buildings and consequently to the date and the method of construction. Emphasis was placed on the importance of the schoolyard both for the educational process and for the psychology of the students and the contribution ...read more

Table 6. Influence on the educational process and student performance by the following factors.

	None %	Little %	Enough %	Much %	Very much %
Temperature	0.7	2.2	18.2	35.8	43.1
Lighting	2.2	2.9	24.1	47.4	23.4
Natural lighting	2.2	4.4	28.5	46	19
Acoustics	2.9	2.2	12.4	35.8	46.7
Ventilation	1.5	2.9	24.1	49.6	21.9

Table 7. Satisfaction level of natural lighting

Satisfaction level	Percent %
Low	3.6
Neutral	16.1
Moderate	55.5
Very good	24.8

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RFID JOURNAL

That 'Internet of Things' Thing

In the real world, things matter more than ideas.

By Kevin Ashton

June 22, 2009—I could be wrong, but I'm fairly sure the phrase "Internet of Things" started life as the title of a presentation I made at Procter & Gamble (P&G) in 1999. Linking the new idea of RFID in P&G's supply chain to the then-red-hot topic of the Internet was more than just a good way to get executive attention. It summed up an important insight—one that 10 years later, after the Internet of Things has become the title of everything from an article in Scientific American to the name of a European Union conference, is still often misunderstood.

The fact that I was probably the first person to say "Internet of Things" doesn't give me any right to control how others use the phrase. But what I meant, and still mean, is this: Today computers—and, therefore, the Internet—are almost wholly dependent on human beings for information. Nearly all of the roughly 50 petabytes (a petabyte is 1,024 terabytes) of data available on the Internet were first captured and created by human beings—by typing, pressing a record button, taking a digital picture or scanning a bar code. Conventional diagrams of the Internet include servers and routers and so on, but they leave out the most numerous and important routers of all: people. The problem is, people have limited time, attention and accuracy—all of which means they are not very good at capturing data about things in the real world.

And that's a big deal. We're physical, and so is our environment. Our economy, society and survival aren't based on ideas or information—they're based on things. You can't eat bits, burn them to stay warm or put them in your gas tank. Ideas and information are important, but things matter much more. Yet today's information technology is so dependent on data originated by people that our computers know more about ideas than things.

If we had computers that knew everything there was to know about things—using data they gathered without any help from us—we would be able to track and count everything, and greatly reduce waste, loss and cost. We would know when things needed replacing, repairing or recalling, and whether they were fresh or past their best.

We need to empower computers with their own means of gathering information, so they can see, hear and smell the world for themselves, in all its random glory. RFID and sensor technology enable computers to observe, identify and understand the world—without the limitations of human-entered data.

Ten years on, we've made a lot of progress, but we in the RFID community need to understand what's so important about what our technology does, and keep advocating for it. It's not just a "bar code on steroids" or a way to speed up toll roads, and we must never allow our vision to shrink to that scale. The Internet of Things has the potential to change the world, just as the Internet did. Maybe even more so.

Kevin Ashton was cofounder and executive director of the Auto-ID Center.

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A Methodology for Saving Energy in Educational Buildings Using an IoT Infrastructure

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The GAIA building manager application is essentially a responsive web-application offering direct visualization of energy consumption and environmental sensing data, while also utilizing participatory sensing in certain scenarios. End-users use it as a means to monitor their school's building status and monitor building performance, i.e., it offers certain building analytics. With respect to building inspection and monitoring, the end-users are able to inspect real-time energy usage where respective meters are available in various timescales (from several minutes to yearly), as well as make comparisons with similar buildings or with the same building in other time spans (e.g., previous years).

The Android GAIA Companion app allows end-users with an Android smartphone to access school building data from the GAIA infrastructure in a more immediate manner. Although it does not have the range of visualization options offered by

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A Methodology for Saving Energy in Educational Buildings Using an IoT Infrastructure

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A. The GAIA Infrastructure

The real-world IoT deployment developed through the GAIA project provides real-time monitoring of 23 school buildings spread in 3 countries (Greece, Italy and Sweden). Of these buildings, the ones in Greece (19 in total) are situated in different local climatic conditions (suburban and rural

Fig. 1. Examples of the IoT infrastructure located inside school buildings in Greece (a-b) IoT nodes based on Arduino and Raspberry Pi, c) actual node inside a classroom, d) a power meter installed inside a distribution board at a Greek school, along with photos from the exterior of some of the school buildings.

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Use of Drone and Infrared Camera for a Campus Building Envelope Study

Raheem Taiwo Ariwoola
East Tennessee State University

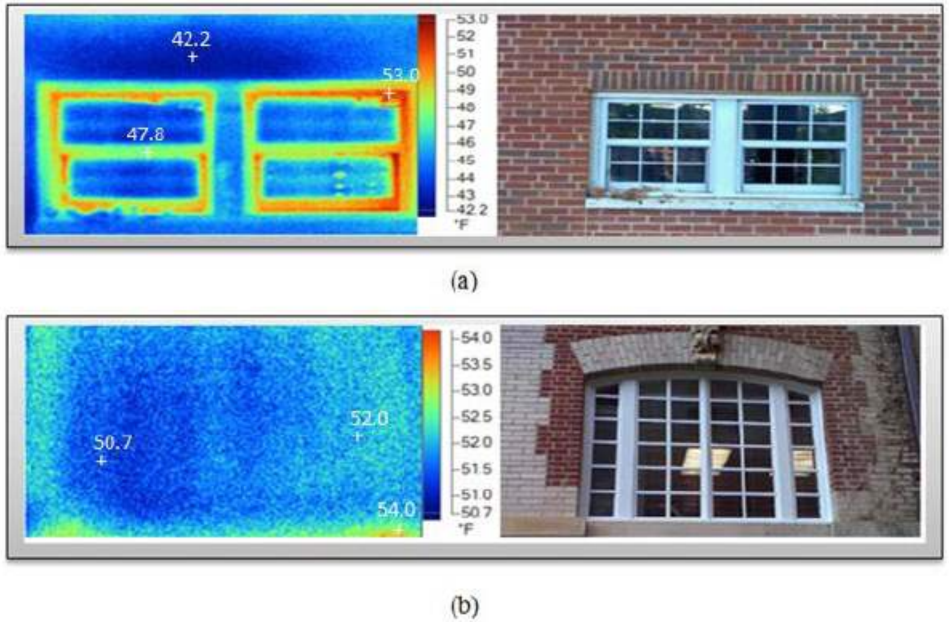

Figure 11 (a & b). Samples of Thermal and Visible Light Images of a Window in Building 1 and 3

The window shown in Figure 11a, displays insulation defects around the frames, however, Figure 11b shows a sample of a window that has a very good resistance to heat transfer. Major defects common to doors are exfiltration through openings, edges or perforated holes on door surfaces as can be seen in Figure 12a, 12b, and 12c. More thermal and visible light images showing window defects are given in appendix B while other samples of door defects and exfiltration are illustrated in appendix C.

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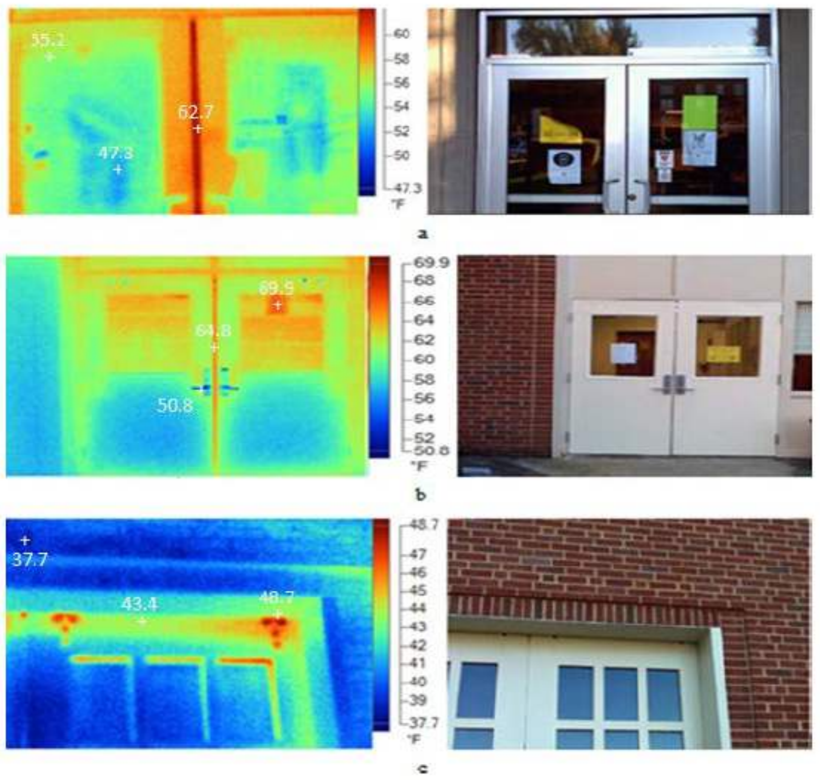

Figure 12 (a, b, and c). Thermal and Visible Light Images showing Exfiltration the Doors

Other defects noticed in the building elements are air leaks due to cracks in walls, moisture detection, thermal bridges and improper insulations. Figure 13a shows gradual amount of heat loss through the wall of building 1 due to cracks in the wall.

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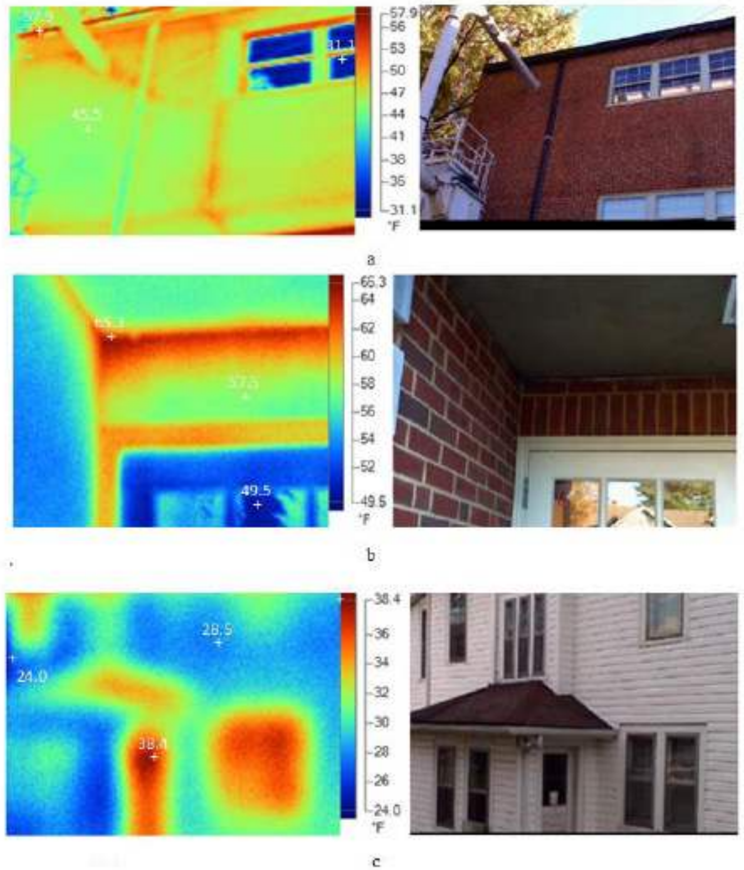

Figure13 (a, b, and c). Thermal and Visible Light Images Showing Heat Loss Due to Wall Cracks and Thermal Bridges

Other samples of wall defects, thermal bridges and moisture defects are given in appendix D.

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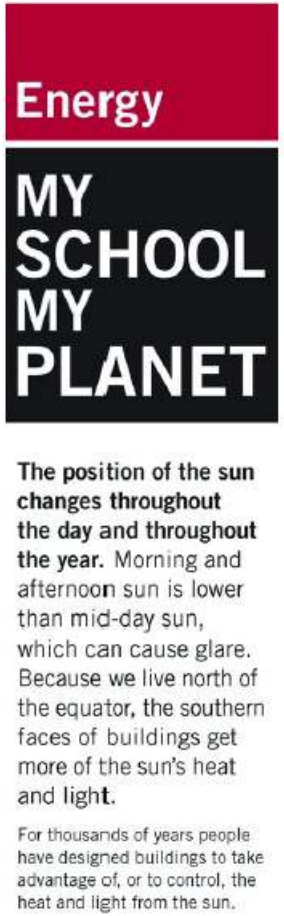
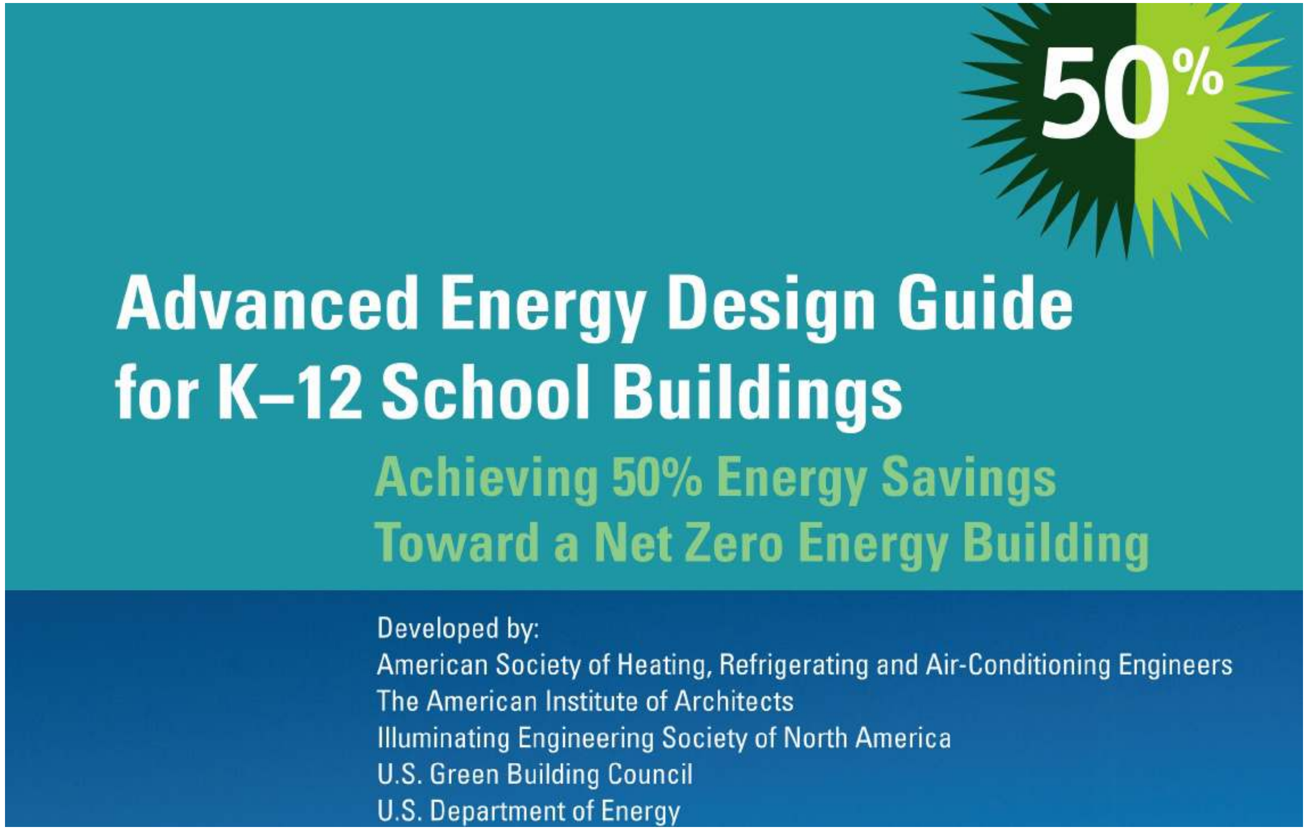

Energy

MY SCHOOL MY PLANET

The position of the sun changes throughout the day and throughout the year. Morning and afternoon sun is lower than mid-day sun, which can cause glare. Because we live north of the equator, the southern faces of buildings get more of the sun's heat and light.

For thousands of years people have designed buildings to take advantage of, or to control, the heat and light from the sun.


50%

Advanced Energy Design Guide for K–12 School Buildings

Achieving 50% Energy Savings Toward a Net Zero Energy Building

Developed by:
American Society of Heating, Refrigerating and Air-Conditioning Engineers
The American Institute of Architects
Illuminating Engineering Society of North America
U.S. Green Building Council
U.S. Department of Energy

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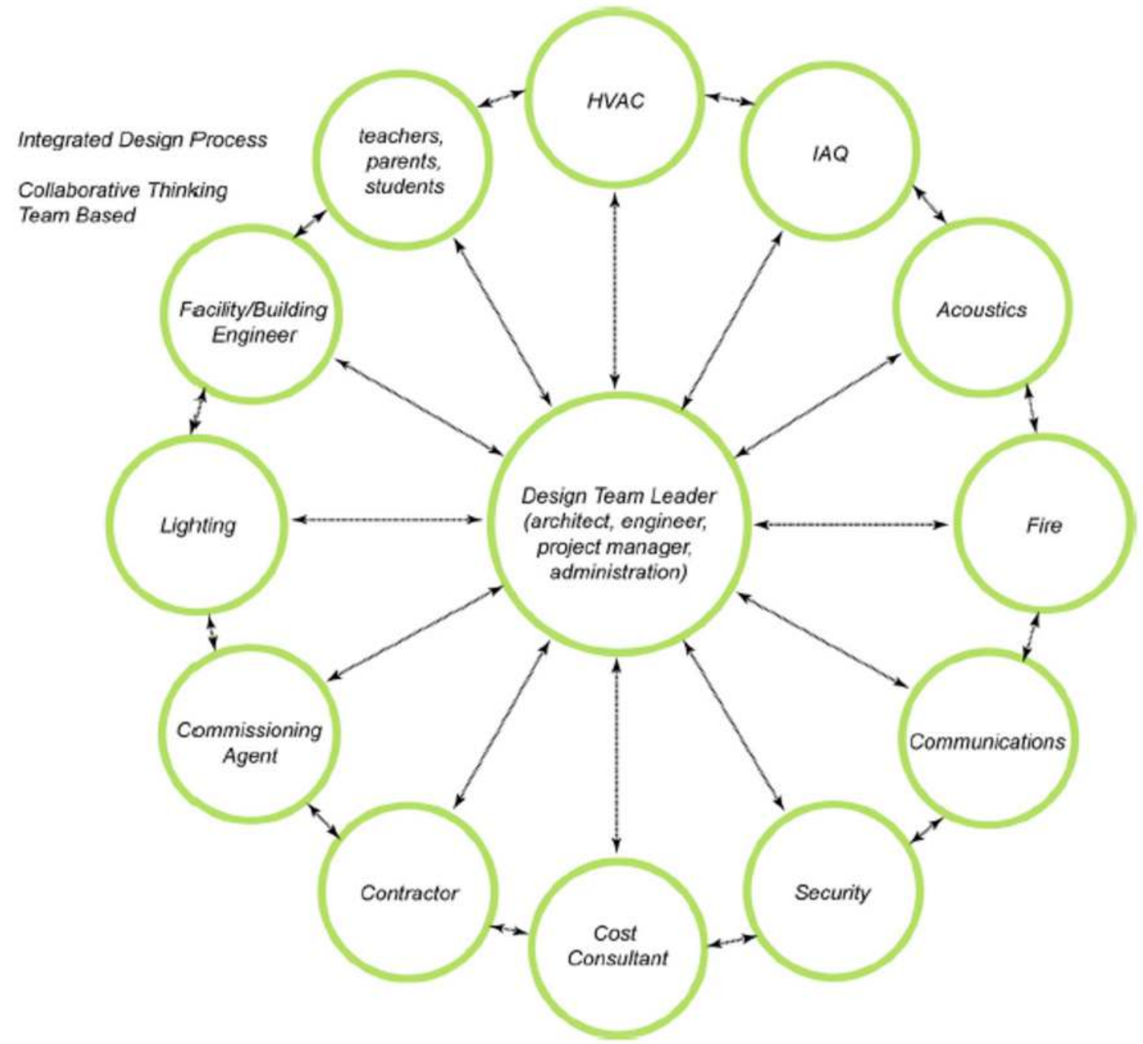

Figure 2-2 Integrated Project Design Team

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Climate Zone	Plug/Process Loads, $kBtu/ft^2 \cdot yr$	Lighting, $kBtu/ft^2 \cdot yr$	HVAC, $kBtu/ft^2 \cdot yr$	Total, $kBtu/ft^2 \cdot yr$
1A	8	7	21	36
2A			21	36
2B			21	36
3A			18	33
3B:CA			10	25
3B			17	32
3C			13	28
4A			22	37
4B			18	33
4C			19	34
5A			25	40
5B			21	36
6A			31	46
6B			26	41
7			34	49
8			48	63

Literature and background

Climate Zone 2 Recommendation Table for K-12 School Buildings

	Item	Component	Recommendation	How-To Tips	✓
Envelope	Roofs	Insulation entirely above deck	R-25.0 c.i.	EN1,2,17,19,21,22	
		Attic and other	R-38.0	EN1,3,17,19,20,21	
		Metal building	R-19.0 + R-10.0 FC	EN1,4,17,19,21,22	
		Solar Reflectance Index (SRI)	78	EN1	
	Walls	Mass (HC > 7 Btu/ft²)	R-7.6 c.i.	EN5,17,19, 21	
		Steel framed	R-13.0 + R-7.5 c.i.	EN6,17,19, 21	
		Wood framed and other	R-13.0 + R-3.8 c.i.	EN7,17,19, 21	
		Metal building	R-0.0 + R-9.8 c.i.	EN8,17,19, 21	
		Below grade walls	Comply with Standard 90.1*	EN17,19, 21	
	Floors	Mass	R-10.4 c.i.	EN10,17,19, 21	
		Steel framed	R-19.0	EN11,17,19, 21	
		Wood framed and other	R-19.0	EN11,17,19, 21	
	Slabs	Unheated	Comply with Standard 90.1*	EN17,19, 21	
		Heated	R-10 for 24 in.	EN13,14,17,19,21, 22	
	Doors	Swinging	U-0.70	EN15,17	
		Nonswinging	U-0.50	EN16,17	
	Vestibules	At building entrance	Comply with Standard 90.1*	EN17	
	View Fenestration	Thermal transmittance	Nonmetal framing = U-0.45 Metal framing = U-0.64	EN24	
		Fenestration-to-floor-area ratio (FFR)	E or W orientation = 5% maximum N or S orientation = 7% maximum	EN24–25	
		Solar heat gain coefficient (SHGC)	E or W orientation = 0.25 N orientation = 0.62 S orientation = 0.50	EN24,28–29	
		Exterior sun control	S orientation only = PF-0.5	EN26	
	Daylight Fenestration	Visible transmittance (VT)	See Table 5-5 for appropriate VT value	DL1,5–6,23	
		Interior/exterior sun control (S orientation only)	S orientation = no glare during school hours	DL1,9,12,13,31	
Daylighting/Lighting	Daylighting	Classroom, resource rooms, cafeteria, gym, and multipurpose rooms	Daylight 100% of floor area for 2/3 of school hours	DL1–5,7–21, 24–30,32–41	
		Administration areas	Daylight perimeter floor area (15 ft) for 2/3 of school hours	DL1–5,8–12	
	Interior Finishes	Interior surface average reflectance for daylighted rooms	Ceilings = 80% Wall surfaces = 70%	DL14	
	Interior Lighting	Lighting power density (LPD)	Whole building = 0.70 W/ft² Gyms, multipurpose rooms = 1.0 W/ft² Classrooms, art rooms, kitchens, libraries, media centers= 0.8 W/ft² Cafeterias, lobbies = 0.7 W/ft² Offices = 0.60 W/ft² Auditoriums, restrooms = 0.5 W/ft² Corridors, mechanical rooms = 0.4 W/ft²	EL12–19	
		Light source lamp efficacy mean lumens per watt)	T8 & T5 > 2 ft = 92, T8 & T5 ≤ 2 ft = 85, All other > 50	EL4–6	
		T8 ballasts	Non-dimming = NEMA Premium Instant Start Dimming= NEMA Premium Program Start	EL4–6	
		T5/T5HO ballasts	Electronic program start		
		CFL and HID ballasts	Electronic		
		Dimming controls daylight harvesting	Dim all fixtures in daylight zones	EL8,9,11–19	
		Lighting controls	Manual ON, auto/timed OFF in all areas as possible	EL8,9,11–20	
	Exterior Lighting	Façade and landscape lighting	LPD = 0.075 W/ft² in LZ-3 & LZ-4 LPD = 0.05 W/ft² in LZ-2 Controls = auto OFF between 12am and 6am	EL23	
		Parking lots and drives	LPD = 0.1 W/ft² in LZ-3 & LZ-4 LPD = 0.06 W/ft² in LZ-2 Controls = auto reduce to 25% (12am to 6am)	EL21	
		Walkways, plaza, and special feature areas	LPD = 0.16 W/ft² in LZ-3 & LZ-4 LPD = 0.14 W/ft² in LZ-2 Controls = auto reduce to 25% (12am to 6am)	EL22	
		All other exterior lighting	LPD = Comply with Standard 90.1* Controls = auto reduce to 25% (12am to 6am)	EL25	
Plug Loads	Equipment Choices	Laptop computers	Minimum 2/3 of total computers	PL2,3	
		ENERGY STAR equipment	All computers, equipment, and appliances	PL3,5	
		Vending machines	De-lamp and specify best in class efficiency	PL3,5	
	Controls/ Programs	Computer power control	Network control with power saving modes and control off during unoccupied hours	PL2,3	
		Power outlet control	Controllable power outlets with auto OFF during unoccupied hours for classrooms, office, library/ media spaces All plug-in equipment not requiring continuous operation to use controllable outlets	PL3,4	
		Policies	Implement at least one: • District/school policy on allowed equipment • School energy teams	PL3,4	

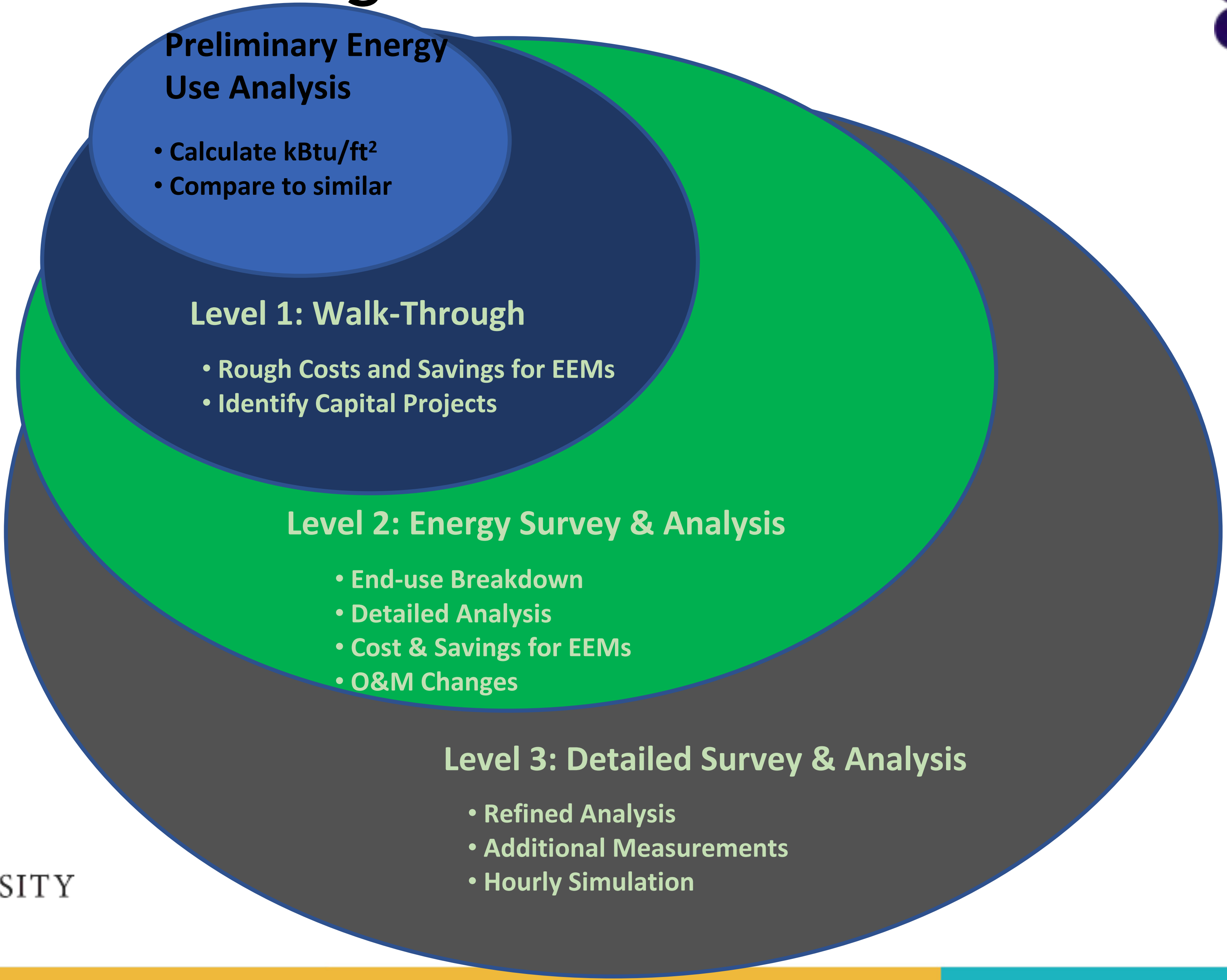
*Note: Where the table says "Comply with Standard 90.1," the user must meet the more stringent of either the applicable version of ASHRAE/IES Standard 90.1 or the local code requirements.

Literature and background

	Item	Component	Recommendation	How-To Tips	✓
Kitchen	Kitchen Equipment	Cooking equipment	ENERGY STAR or California rebate-qualified equipment	KE1,2	
		Walk-in refrigeration equipment	6 in. insulation on low-temp walk-in equipment, Insulated floor, LED lighting, floating-head pressure controls, liquid pressure amplifier, subcooled liquid refrigerant, evaporative condenser	KE2,5	
		Exhaust hoods	Side panels, larger overhangs, rear seal at appliances, proximity hoods, VAV demand-based exhaust	KE3,6	
SWH	Service Water Heating	Gas water heater (condensing)	95% efficiency	WH1–5	
		Electric storage EF (≤12 kW, ≥20 gal)	EF > 0.99 – 0.0012 × Volume	WH1–5	
		Point-of-use heater selection	0.81 EF or 81% E_t	WH1–5	
		Electric heat-pump water heater efficiency	COP 3.0 (interior heat source)	WH1–5	
		Solar hot-water heating	30% solar hot-water fraction when LCC effective	WH7	
		Pipe insulation (d < 1.5 in./d ≥ 1.5 in.)	1/1.5 in.	WH6	
HVAC	Ground Source Heat-Pump (GSHP) System with DOAS	GSHP cooling efficiency	17.1 EER	HV1,11	
		GSHP heating efficiency	3.6 COP	HV1,11	
		GSHP compressor capacity control	Two stage or variable speed	HV1,11	
		Water-circulation pumps	VFD and NEMA Premium Efficiency	HV8	
		Cooling tower/fluid cooler	VFD on fans	HV1,8,11	
		Boiler efficiency	90% E_c	HV1,7,11	
		Maximum fan power	0.4 W/cfm	HV12	
		Exhaust air energy recovery in DOAS	A (humid) zones = 60% enthalpy reduction B (dry) zones = 60% dry-bulb temperature reduction	HV4,5	
		DOAS ventilation control	DCV with VFD	HV4,10,15	
	Fan-Coil System with DOAS	Water-cooled chiller efficiency	Comply with Standard 90.1*	HV2,6,11	
		Water circulation pumps	VFD and NEMA Premium Efficiency	HV6,7	
		Boiler efficiency	90% E_c	HV2,7,11	
		Maximum fan power	0.4 W/cfm	HV12	
		FCU fans	Multiple speed	HV2,12	
		Economizer	Comply with Standard 90.1*	HV2,14	
		Exhaust air energy recovery in DOAS	A (humid) zones = 60% enthalpy reduction B (dry) zones = 60% dry-bulb temperature reduction	HV4, 5	
		DOAS ventilation control	DCV with VFD	HV4,10,15	
	VAV Air-Handling System with DOAS	Air-cooled chiller efficiency	10 EER; 12.75 IPLV	HV3,6,11	
		Water-cooled chiller efficiency	Comply with Standard 90.1*	HV3,6,11	
		Water circulation pumps	VFD and NEMA Premium Efficiency	HV6,7	
		Boiler efficiency	90% E_c	HV3,7,11	
		Maximum fan power	0.6 W/cfm	HV12	
		Economizer	Comply with Standard 90.1*	HV3,14	
		Exhaust air energy recovery in DOAS	A (humid) zones = 60% enthalpy reduction B (dry) zones = 60% dry-bulb temperature reduction	HV4,5	
		DOAS ventilation control	DCV with VFD	HV4,10,15	
	Ducts and Dampers	Outdoor air damper	Motorized damper	HV10	
		Duct seal class	Seal Class A	HV20	
		Insulation level	R-6	HV19	
M&V	M&V/ Benchmarking	Electrical submeters	Disaggregate submeters for lighting, HVAC, general 120V, renewables, and whole building	QA14–17	
		Benchmarking	Begin submetering early to address issues during warranty period Benchmark monthly energy use Provide training on benchmarking	QA14–17	

*Note: Where the table says "Comply with Standard 90.1," the user must meet the more stringent of either the applicable version of ASHRAE/IES Standard 90.1 or the local code requirements.

Literature and background



Project importance

BRITISH COUNCIL

Human-Building Relation

Energy & Buildings

Environment & Energy prices

Sharing Expertise

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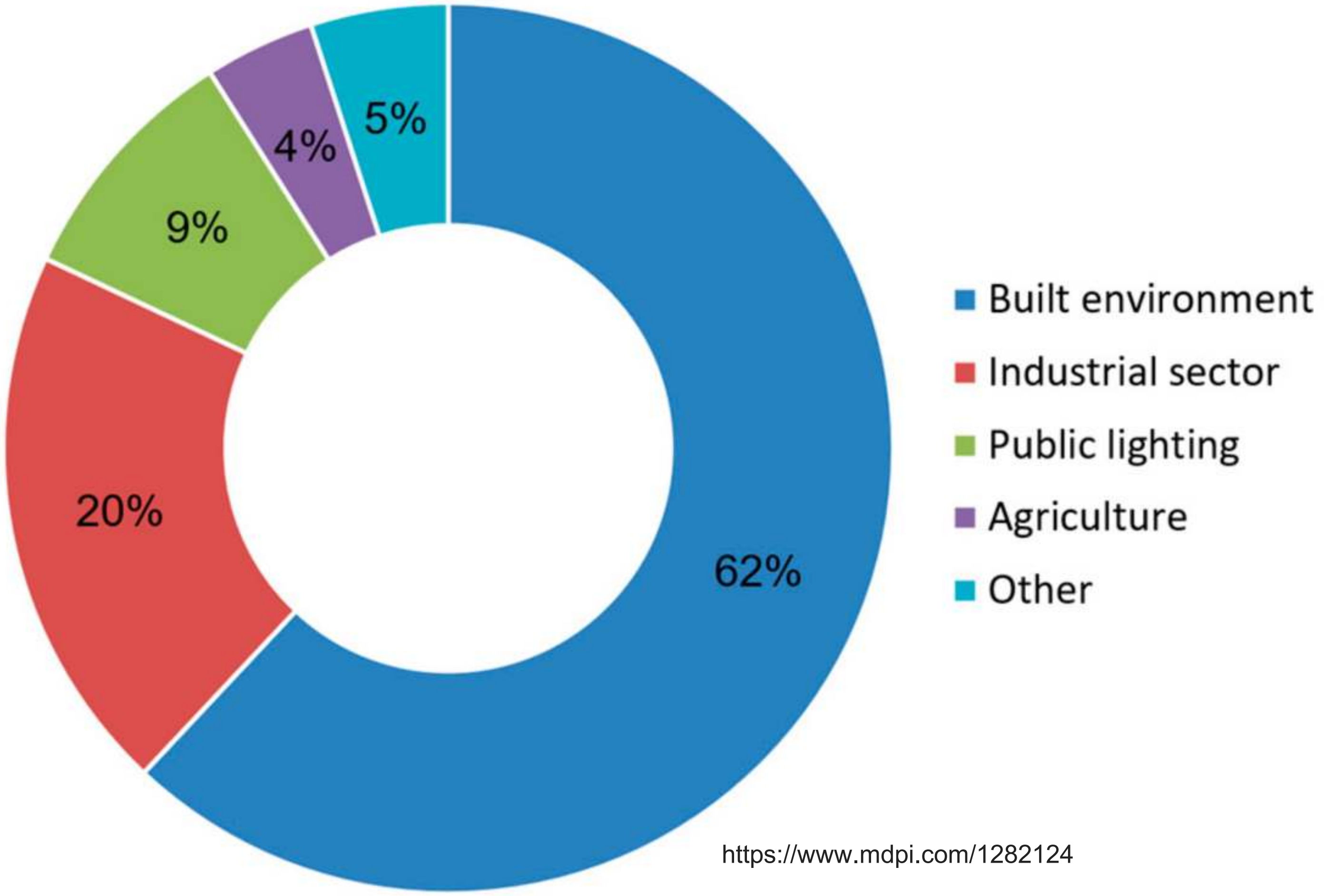

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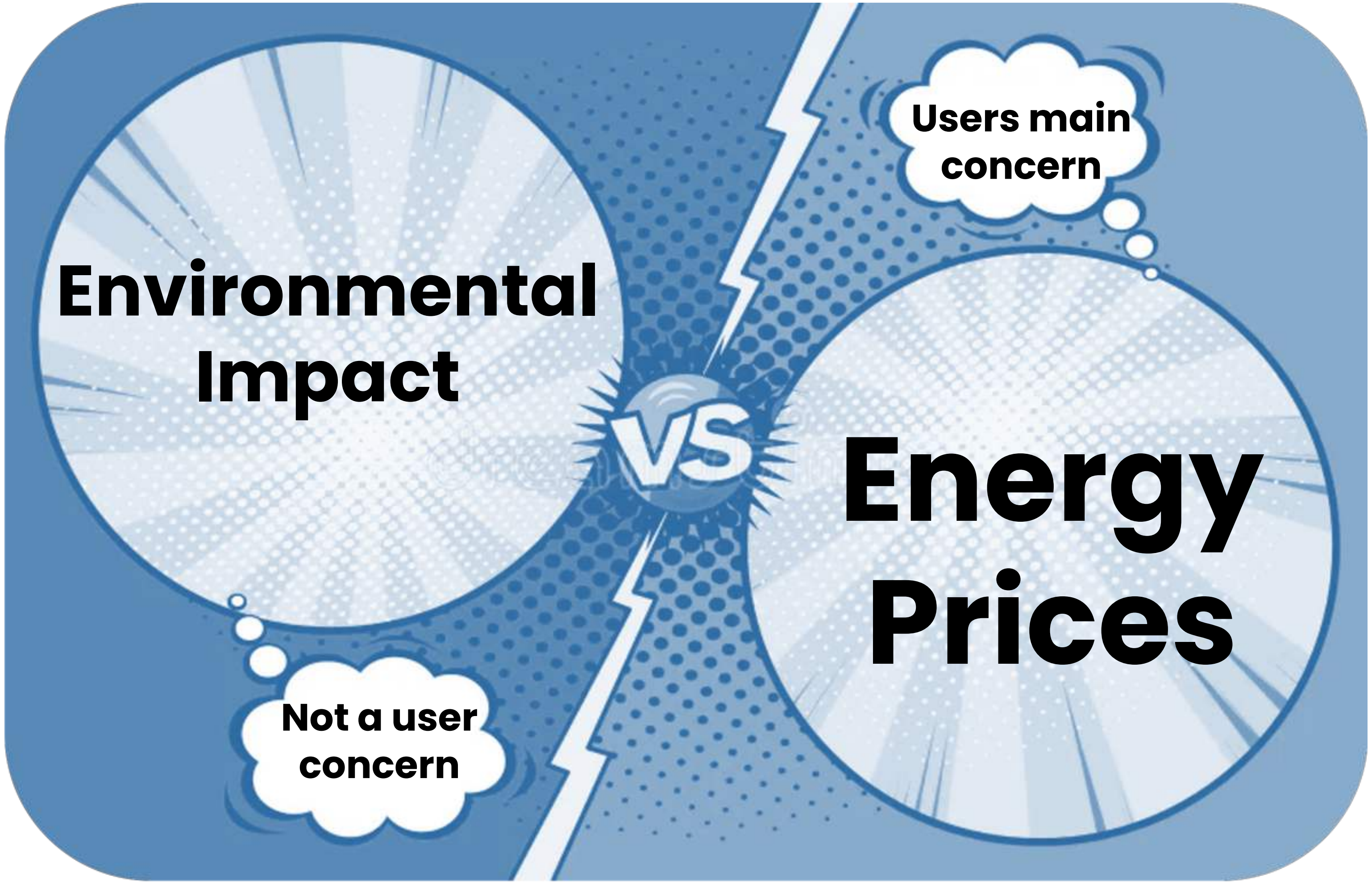

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Session 2 – outline (LSBU)

Welcome

Introductions

Introduction to SusHumBuild

BUE Team

LSBU Team

Workstream

Programme of Work

Housekeeping

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Project Aim

The main aim of the project is to **build research links between LSBU and BUE and to develop a guidelines manual** that can used to promote sustainable building practices and energy efficiency awareness, with a particular focus on educational buildings.

OBJECTIVES

1. To identify the challenges for implementing a sustainable energy-efficient culture in educational buildings in Egypt.
2. Increase the awareness to invest in energy-saving measures and their knowledge about the return on investment (ROI) and overshadow the long-term benefits of reduced energy consumption.
3. Introduce the integration of smart technologies for energy management to be widespread across all educational buildings.
4. Investigate the current UK's significant strides in sustainable energy practices in energy-saving awareness within its building sector for achieving greater efficiency and reducing environmental impact.
5. Disseminate the findings through a workshop in Cairo, Egypt.

BUE Teams

LSBU Teams

Dr. Ahmad Elshamy (Co-PI)

Dr. Hesham Safwat (PI)

Prof. Iman Elmahallawy

Eng. Engy Elshazly

Eng. Mahmoud ElGharib

Dr. Rania Rushdy

Dr Bertug Ozarisoy

Dr Mubarak Abdelrasoul Elnour Ismail

Dr Zhihui Ye

Professor Issa Chaer

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Work Packages

WP1	Research the current state of energy efficiency implementation in educational buildings for Egypt focusing on the user engagement with the energy using systems and understanding the energy use. This will include literature review, data collection and building performance evaluation survey.	Output (OP): Report of the current user engagement. Outcome (OC): Clarify the interplay between different factors affecting energy user behaviour in Egypt.	0-3 months	BUE
WP2	Appraise current energy saving methodologies for educational buildings in the UK and use dynamic thermal modelling and simulation to investigate different optimisation scenarios that are applicable to Egypt.	OP: Report of the latest advancement in energy saving within educational buildings. OC: Appraised up-to-date knowledge on the energy saving approaches in the UK for educational buildings.	0- 3 months	LSBU
WP3	Facilitation site visits and knowledge transfer between LSBU BUE teams and relevant industry stakeholder. Hands on site visit to the Centre for Efficient and Renewable Energy in Buildings at LSBU. Charrat meetings relating to the operation of energy systems.	OP: Sharing the UK expertise for building energy efficiency transition and implementation through joint activities and workshops. OC: Improve the knowledge exchange between the UK and Egypt.	3-6 months	LSBU

Work Packages- Cont.

WP4	•Analysis of energy performance data for higher education buildings from both the UK and Egypt, taking into account the different climate characteristics of Egypt and the UK as well as microclimates. •Sharing the UK expertise for building energy efficiency transition and implementation through joint activities and workshops.	OP: Develop the outline for guidelines for the higher education buildings in Egypt. OC: Tailoring the knowledge into the codes for the higher education buildings in Egypt.	6- 9 months	LSBU and BUE
WP5	•Evaluation of the guideline with academics, professionals, stakeholders and representatives of local authorities.	OP: Guidelines for energy savings. OC: Increase understanding energy saving and sustainability	9-11 months	LSBU and BUE
WP6	•Disseminate workshop on the outputs through development of training material and masterclass workshop in Cairo, Egypt.	OP: Awareness workshop in energy efficiency. OC: Widened research collaboration between the UK and Egypt.	11-12 months	LSBU and BUE

Measure of Success

Establish a knowledge nexus that delivers benefits and guidelines to end users and operators of energy systems.

Training, workshops and joint collaborations between the LSBU and BUE.

Aiming to train approximately 20 participants for each workshop which will be held both in the UK and Egypt. Target groups are undergraduate students, postgraduate taught students, early career researchers, academics, architects, engineers and other industry partners.

These workshop series will be laid to develop short courses within these themes as follows: (i) energy performance, (ii) sustainability indicators, and (iii) net-zero energy design principles.

Evidence-based guides to support the operation of Egyptian higher education buildings.

New research collaborations between BUE and LSBU based on the expertise of researchers within the two institutes around Net Zero and energy efficiency, respectively.