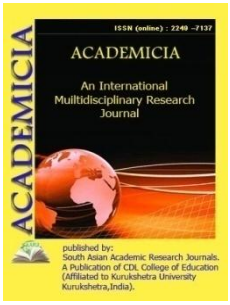
ACADEMICIA

ISSN: 2249-7137 Vol. 11, Issue 10, October 2021 Impact Factor: SJIF 2021 = 7.492

ACADEMICIA
An International Multidisciplinary Research Journal
(Double Blind Refereed & Peer Reviewed Journal)



DOI: 10.5958/2249-7137.2021.02363.6

AN OVERVIEW ON BUILDING ENERGY USAGE INFORMATION

Dr. Amit Sharma*

*Faculty of Engineering, Teerthanker Mahaveer University,
Moradabad, Uttar Pradesh, INDIA
Email id: dramit.engineering@tmu.ac.in

ABSTRACT

Concerns about supply shortages, depletion of energy supplies, and severe environmental consequences have already arisen as a result of the world's fast increasing energy use (global warming, climate change, ozone layer depletion etc.). Buildings' contribution to global power usage, both residential and business, has continuously risen, reaching estimates of 20 to 40 percent in industrialized nations, and has surpassed the contributions of other key sectors such as industry and transportation. The growing trend in energy consumption will continue in the future, thanks to population growth, rising demand for building services including comfort levels, and an increase in time spent within buildings. As a result, building energy efficiency is now a top priority for energy policy at the regional, national, and worldwide levels. The rise in energy consumption of HVAC systems is especially notable among building services (50 percent of building consumption or 20 percent of total consumption in the USA). This study examines the existing data on building energy usage, especially as it relates to HVAC systems. Many questions emerge, such as: Is the information required available? What are the most common kinds of structures? What end uses should be taken into account throughout the breakdown? Specially for commercial structures, comparisons across various nations are given. The case of offices is investigated in more depth.

KEYWORDS: *Building energy use, HVAC consumption, Air conditioning consumption.*

1. INTRODUCTION

Global energy use Concerns about supply shortages, depletion of energy supplies, and severe environmental consequences have already arisen as a result of the world's fast increasing energy use (ozone layer depletion, global warming, climate change, etc.). The International Energy

Agency has compiled alarming statistics on global energy usage patterns. Primary energy has increased by 49% and CO2 emissions by 43% during the past two decades (1984–2004), with an average annual growth of 2% and 1.8 percent, respectively. According to current forecasts, this upward tendency will continue. Energy consumption in developing economies will increase at a 3.2 percent annual pace, surpassing that of developed countries (North America, Western Europe, Japan, Australia, and New Zealand) at a 1.1 percent annual rate by 2020. China's example is remarkable, since it took just 20 years to double its energy consumption at a 3.7 percent annual growth rate. The study of the evolution of the major global energy indicators between 1973 and 2004 yielded some interesting results[1].

- The pace of population growth is much lower than the rate of GDP growth, resulting in significant increases in per capita personal income and global wealth.
- Primary energy consumption is increasing at a faster pace than population, resulting in a 15.7 percent rise in per capita value over the past 30 years.
- CO2 emissions have increased at a slower pace than energy consumption, which has increased by 5% during the same time span.
- Electrical energy consumption has increased dramatically (by more than two-thirds), resulting in a percentage increase in total energy consumption.
- Energy resource efficiency, as measured by the relationship between final and primary energy, has decreased by 7%, owing mostly to rising electricity use.
- Final and primary energy intensities have decreased as a consequence of GDP growth outpacing the rate of increase in energy consumption, resulting in an overall improvement in global energy efficiency.

1.2.Building energy usage:

The final energy consumption is typically broken down into three categories: industrial, transportation, and ‘other,' which includes agricultural, the service sector, and residential. This makes gathering statistics on building energy usage very challenging. Energy consumption in structures other than homes, for example, accounts for a small portion of the services provided by the ‘other' important sector. Given its importance in industrialized nations (buildings account for 20–40% of total final energy consumption), we think it should be included separately as the third major sector, with domestic and nondomestic buildings separated at the very least[2].

Building energy consumption has surpassed that of transportation and industry as a result of population growth, improved building services and comfort levels, and an increase in time spent within buildings. Buildings have had a major impact on the ratio of industry (down nine points) and the growth of ‘other' (up six points). The phrase "other sectors" is vague and causes a lot of misunderstanding. Many international, national, and regional sources contain a variety of end applications in this notion, making comparisons difficult. Finally, we consider the development and significance of building energy use[3].

Building energy consumption in the UK has risen at a pace of 0.5 percent each year, somewhat less than the European average of 1.5 percent. Building energy usage in Spain, on the other hand,

is growing at a pace of 4.2 percent per year, far above the European (1.8 percent) and North American (1.8 percent) rates. Economic development, the rise of the construction industry, and the proliferation of building services, particularly heating, ventilation, and air conditioning (HVAC) systems, are all factors. (2) Buildings used 37 percent of final energy in the EU in 2004, more than industry (28 percent) and transportation combined (33 percent). The percentage of energy used in buildings in the UK (39%) is somewhat higher than the European average. This is due in part to the move away from heavy industries and toward activity in the service sector. In comparison, the proportion for Spanish buildings is just 24%, 14 points lower than the European norm, and is projected to increase sharply as economic development brings the country closer to the European average[4].Many types of buildings (schools, restaurants, hotels, health facilities, museums, and so on) with a wide range of purposes as well as energy services (HVAC, water heating (DHW), lighting, refrigeration, food preparation, and so on) are included in the service sector, which covers all commercial and public buildings. Size of the economy raises the demand for services (health, culture, leisure, education and so on) as well as energy usage. Since the 1950s, energy consumption in the service sector has increased from 11% to 18% in the United States[5].

1.3.HVAC (heating, ventilation, as well as air conditioning) is a term that refers to (HVAC):

Energy efficiency or savings techniques have become a key goal for most nations' energy policies due to the growth of energy use and CO2 emissions in the built environment. The European Energy Performance of Buildings Directive is a good example (EPBD). The escalation of energy consumption in HVAC systems, which has now become practically necessary in tandem with the expansion of demand for thermal comfort, which was formerly regarded a luxury, has been particularly significant. Heating, ventilation, as well as air conditioning are the most common energy end uses in both the residential as well as non-residential sectors. When compared to other end users, its dominance is apparent. It uses approximately half as much energy as DHW and is more than twice as efficient. IDAE estimates HVAC energy consumption in non-domestic buildings to be approximately 48 percent, which is still lower than the 57 percent in the United States and comparable to other sources[5].

In Europe, data provided by governments at the national, regional, and municipal levels is inadequate for effectively planning future building energy regulations and coordinating actions to meet each of the end uses. Governments should fund sector-specific analyses, such as those produced by the EIA for residential and commercial buildings, so that a comprehensive data set of the building stock and energy parameters (consumption, expenditures, fuels, end uses, and so on) can be used to plan for the future. In most industrialized nations, HVAC usage accounts for half of all energy consumption in buildings and a fifth of total national energy consumption. Furthermore, projections show a huge increase in energy consumption and conditioned area in the EU over the next 15 years, with an increase of about 50%.

1.4.Non-domestic structures:

The kind of usage and activities in non-domestic buildings have a significant effect on the quality and amount of energy services required. Few sources, however, provide data by typology, and there is no uniform categorization, making analysis very difficult. Following a review of various sources, the following basic conclusions may be drawn: (1) In recent years,

energy consumption in this sector in the United Kingdom has stabilized, with increases in floor space and service levels being compensated by efficiency gains. Commercial energy consumption is growing faster than other sectors in the rest of Europe, owing mostly to the growth of HVAC systems in new buildings. In the UK, new service sector construction rates are usually about 2%, while in Spain, the average annual rate of growth since 2000 has been 6.1 percent, with projections indicating that this will continue to rise. In 2003, this sector accounted for 11% of total energy consumption, which was comparable to the United States (18%) and the European Union (EU) (11 percent). Despite having the fastest growth rate, energy regulations have tended to concentrate on the residential and industrial sectors, leaving the service sector out[6].

- The most power typologies are office and retail, which account for more than half of all non-domestic building energy use. Hospitals and schools, as well as hotels and restaurants.
- With a weight of close to 50%, HVAC is the most important end use, followed by lights (15%) and appliances (10%). The distribution of energy end uses (Fig. 5) and their energy intensity are both influenced by the kind of building. This necessitates the creation of separate research per building type.

1.5.Buildings that house offices:

Office buildings, together with retail, have the highest consumption and CO2 emissions in the business sector. In the United States, offices account up 17% of total non-domestic space and approximately 18% of total energy use, or 3.2 percent of total consumption. They account for a third of business sector energy consumption and almost 2.7 percent of overall energy consumption in Spain, and 17 percent of energy consumption and 2% of total energy usage in the United Kingdom. As a result, it's a good idea to start with office buildings while doing a commercial study. Other factors that support this type of energy surveys include[7].

A significant rise in the overall constructed area of office buildings as a result of economic success, with numerous new commercial projects in the outskirts of major cities. In Spain, 9.3 million square meters were constructed between 1990 and 2000, with no accurate data on the overall developed area. The per capita area in the United States is about 4 m2, which is much higher than the European number of 2 m2. Between 2000 and 2005, the overall floor space of offices in the United Kingdom grew by around 4%.

The quantity of artificial lighting needed, as well as the usage of IT equipment and the use of air conditioning, has constantly risen. More than 90% of businesses in Spain utilize IT technology, and almost all new offices are air-conditioned. Even in milder climates, such as the United Kingdom, more than half of new workplaces are air-conditioned.It's a typology that's very consistent throughout the building portfolio, both in terms of envelope as well as building services, with three major energy end uses, HVAC, lighting, or appliances, accounting for about 85% of total energy consumption[8].

LITERATURE REVIEW

Hye Sun et al. studied about The Korean government has set a goal of decreasing greenhouse gas emissions by 37% by 2030 compared to business-as-usual (BAU) levels. Because the

construction industry is so essential for reducing greenhouse gas emissions, numerous measures to decrease building energy are being reinforced. As a result, a nationwide research effort is underway to install systems for continuous monitoring of energy consumption by end use in sample buildings, as well as to develop a reference power intensity (EUI) database as well as benchmarking system for comparison analysis. The research also discovered methods for measuring such usage and converting the findings into EUI data. As examples, forty complexes with a total of 200 units were chosen. The sample building installation will take place in stages over the next four years, beginning in 2015, and systems have already been installed in ten complexes and 50 units. After 2020, a reference EUI database for residential buildings will be accessible, as will a benchmarking tool based on the database, and equivalent systems for office towers are now being developed[9].

Kang et al. studied about The growing need for sustainable smart buildings necessitates the development of an efficient decision-making approach for managing building energy consumption. Data-mining techniques that utilize different data types will be required in the future for decision-making assistance in BIM-based power management. A rule-set-based Building information modelling data-mining approach for data integration as well as function extension support is proposed here, which takes functional variability and extensibility into account. Its efficiency was shown by the construction and implementation of a building-energy-management scenario, as well as the analysis of the outcomes. Based on the results of the work effectiveness study, we discovered that the suggested approach increased the efficacy by 14.4 to 20.5 times. Users may obtain intuitive BIM-based decision-making information and adapt the flexible process for different use cases using the suggested approach[10].

DISCUSSION

As a result of the world's rapidly growing energy consumption, concerns about supply problems, depletion of energy sources, and severe environmental repercussions have already emerged. Buildings' contribution to world energy consumption, whether residential or commercial, has steadily increased, reaching estimates of 20 to 42 percent in developed countries and surpassing other important sectors such as plants and vehicles. Because of population expansion, increasing demand for building services or comfort levels, as well as an increase in time spent inside buildings, the rising trend in energy consumption will continue in the future.

As a consequence, energy efficiency in buildings is now a major concern for regional, national, and global energy policy. As the growth of carbon dioxide emissions on the built environment has led to the creation of new building standards and certification systems that now include minimum requirements, energy efficiency measures have become a priority for energy policy. As the need for thermal comfort has solidified, HVAC systems (and their associated energy consumption) have become an unavoidable asset, accounting for almost half of the energy consumed in buildings and around 10–20 percent of total energy consumption in developed countries. The increasing trend in construction energy use will continue in the next years, as long as resource use and environmental depletion or global downturn do not intervene. To attain a sustainable energy future, private initiative, in conjunction with government action, will be needed to encourage energy efficiency, new energy production technologies, limiting energy use, and raising public knowledge about energy usage.

CONCLUSION

Building energy consumption accounts for 20–40% of overall energy consumption in industrialized nations, and is higher than that of industry and transportation in the EU and the US. However, the information provided is obviously inadequate and not proportionate to the significance of the issue. It is not regarded as a separate sector, and there is a scarcity of reliable data, making it difficult to comprehend the underlying changes that influence energy use in this industry. It is critical to make complete building energy data accessible in order to conduct appropriate analyses and effectively plan future energy strategies. In this regard, the EIA's research on the energy use of residential and commercial buildings in the United States are a useful resource.

Energy efficiency measures have been a priority for energy policies as the proliferation of energy consumption and CO2 emissions on the built environment has led to the development of new building standards and certification systems that now contain minimum criteria. HVAC systems (and their related energy consumption) have become an inescapable asset as the demand for thermal comfort has consolidated, accounting for almost half of the energy used in buildings and approximately 10–20 percent of total energy consumption in industrialized nations. Due to the growth of built area as well as related energy requirements, the rising trend in building energy consumption will continue in the future years, as long as resource and environmental depletion or economic recession do not prevent it. To attain sustainable energy economy, private initiative, in combination with government action, will be required to promote energy efficiency, new technologies for energy generation, restricting energy consumption, or increasing societal awareness about the rational use of energy.

REFERENCES

1. K. A. Agyeman, S. Han, and S. Han, “Real-time recognition non-intrusive electrical appliance monitoring algorithm for a residential building energy management system,” *Energies*, 2015, doi: 10.3390/en8099029.

2. Z. Ma, R. Yan, K. Li, and N. Nord, “Building energy performance assessment using volatility change based symbolic transformation and hierarchical clustering,” *Energy Build.*, 2018, doi: 10.1016/j.enbuild.2018.02.015.

3. B. Dave, A. Buda, A. Nurminen, and K. Främling, “A framework for integrating BIM and IoT through open standards,” *Autom. Constr.*, 2018, doi: 10.1016/j.autcon.2018.07.022.

4. T. Ahmad, H. Chen, Y. Guo, and J. Wang, “A comprehensive overview on the data driven and large scale based approaches for forecasting of building energy demand: A review,” *Energy and Buildings*. 2018, doi: 10.1016/j.enbuild.2018.01.017.

5. M. V. Shoubi, M. V. Shoubi, A. Bagchi, and A. S. Barough, “Reducing the operational energy demand in buildings using building information modeling tools and sustainability approaches,” *Ain Shams Eng. J.*, 2015, doi: 10.1016/j.asej.2014.09.006.

6. C. J. Chen, S. Y. Chen, S. H. Li, and H. T. Chiu, “Green BIM-based building energy performance analysis,” *Comput. Aided. Des. Appl.*, 2017, doi: 10.1080/16864360.2016.1273582.

7. M. Mangold, M. österbring, C. Overland, T. Johansson, and H. Wallbaum, "Building ownership, renovation investments, and energy performance-A study of multi-family dwellings in Gothenburg," *Sustain.*, 2018, doi: 10.3390/su10051684.

8. E. Fuentes, L. Arce, and J. Salom, "A review of domestic hot water consumption profiles for application in systems and buildings energy performance analysis," *Renewable and Sustainable Energy Reviews*. 2018, doi: 10.1016/j.rser.2017.05.229.

9. H. S. Jin, B. H. Choi, J. K. Kang, S. I. Kim, J. H. Lim, and S. Y. Song, "Measurement and Normalization Methods to Provide Detailed Information on Energy Consumption by Usage in Apartment Buildings," 2016, doi: 10.1016/j.egypro.2016.09.161.

10. T. W. Kang and H. S. Choi, "BIM-based Data Mining Method considering Data Integration and Function Extension," *KSCE J. Civ. Eng.*, 2018, doi: 10.1007/s12205-017-0561-6.