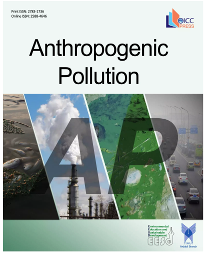

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Designing and presenting an environmental management model with an emphasis on energy management in office buildings (Case study: District 5 Municipality of Tehran, Iran)

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Abstract:
The present applied research aimed to model energy management in office buildings of District 5 Municipality of Tehran, Iran. The components affecting energy consumption were extracted via an integrated approach (including in-depth survey and semi-structured interviews with experts) using coding method and prioritized by Analytic hierarchy process and Expert Choice. The proposed model was fitted by structural equation modeling and the strategies were developed by Hitt's strategic planning model. The results showed 10 components (in three dimensions) as effective factors in energy management. The highest and lowest weight percentages were respectively related to the components of "Using appropriate technology for manufacture and providing and using low-consumption supplies and equipment" (26.8%), and "Implementing green tax policy" (1.7%). Goodness of fit index values for the three domains of the integrated model were 0.942 (for architecture and engineering), 0.941 (for behavioral patterns) and 0.901 (for rules and regulations), which were in the acceptable area due to being more than the standard value (0.9), as well as the root mean square residual values were 0.079, 0.073 and 0.061, respectively, which were in the acceptable area due to being lower than the standard value (0.08). The strategies of "Strengthening the infrastructure and equipment in the field of energy consumption optimization" and "Using green tax and incentive solutions in energy consumption" were placed in the first and last priorities with final weights of 4.16 and 3.156. These findings were a claim for the good and acceptable fit of the proposed 10-component and 9-strategy model.

Keywords: Energy management; Office buildings; Environmental management model; District 5 Municipality of Tehran

1. Introduction

The overconsumption of energy in the last century and the increase in energy demand around the world in recent years have incurred irreparable adverse effects on the environment, such as global warming, pollution of water resources, and the extinction of some animal and plant species. These bottlenecks, along with other challenges such as energy economy and unsafe energy carriers, have raised the issue of sustainable development and paved the way for their development based on sustainability criteria (Darabi 2022).
According to forecasts, global energy consumption will increase by nearly 48% in 2040 compared to the same amount in 2012, and Asia will still be the largest energy consumer in 2040. Meanwhile, over 50% of global energy will be consumed in the industry sector (Mariano-Hernandez et al. 2020).
Energy consumption in Iran has been reported to be more than 2.5 times the average annual global energy consumption. The energy intensity index in Iran is estimated at 0.63%, and subsequently, Russia (0.53%) and Saudi Arabia (0.51%) have occupied the next positions, respectively. According to the latest statistics, Iran is known as the ninth

energy consumer in the world, and such energy consumption means 3.4 million barrels of crude oil (Hesami 2020). Improving urban energy efficiency not only helps save energy, but also leads to the development of cities' budgets, improved services and increased competition in this field (IDE 2019; Nodeh et al. 2021). Since a large part of electricity in Iran is produced by thermal power plants, high consumption of electrical energy means high consumption of non-renewable fossil fuels. Electricity consumption of buildings in Iran has doubled in the last 10 years. According to the statistical data of the Ministry of Energy, per capita energy consumption in Iran is three times that of industrialized countries, and a large part of this difference is caused by energy losses in the construction sector (Bahrami and Davoudi 2004). The survey of per capita energy consumption in Iran between 2004 and 2011 shows a 25% increase in these years; the per capita energy consumption in Iran is estimated to be more than 5 times that of Indonesia (with a population of 225 million), 2 times that of China (with a population of 1.3 billion), and 4 times that of India (with a population of 1.122 billion (Bahmanpour et al. 2021).

Considering the limited energy resources in Iran and taking into account the national approach to reduce dependence on oil resources, the need to reduce energy consumption in various sectors of industry and construction is considered as the first candidate in the field of attention to energy saving solutions (Jabari et al. 2013). Among the environmental challenges in urban management that must be planned and managed in an integrated and systematic manner (Fataei and Alsheikh 2009; Nami et al. 2017), reducing the high costs of energy consumption in buildings and especially office ones, paying attention to preserving the environment and reducing environmental problems are among the concerns that are receiving more attention every day. Environmental management of energy in buildings is a creative and cost-effective solution to achieve environmentally friendly buildings (Pallante et al. 2020). The building sector accounts for more than a third of energy consumption, with an annual value of over six billion dollars. The vast majority of buildings in Iran lack technical standards set to prevent the loss of cooling or heating energy (Tatar and Marafet 2013). Public buildings account for 70% of energy consumption in this sector, and old buildings generally show between 40 and 60% of energy loss. According to the balance of electrical energy consumption in an office building in Iran, cooling and air conditioning accounted for the largest share (40%) of this type of consumption, followed by lighting (25%), heating and hot water consumption (19%) and other electrical appliances (15%). Following the implementation of comprehensive plans in the field of optimizing energy consumption, including the formulation of executive guidelines for "optimizing the consumption of energy resources (water, electricity and gas) in the buildings of the municipality of Tehran, Iran", it has been tried to avoid energy waste, reduce economic costs and improve the quality of the urban environment (Kazemi and Kazemi 2017).

Tehran Municipality has been one of the leading organizations in optimizing energy consumption in buildings under its authority. Currently, the main challenge of energy management in the buildings of Tehran Municipality is the existence of over 1000 office buildings in an area of about 1000 hectares and high consumption of energy resources. In these spaces, more than 60,000 people are consuming energy daily during the peak hours of energy consumption (from 7:00 am to 5:00 pm) without any specific instructions, although there is no specific database in this field. Hence, the preparation of a data bank with specific indicators of energy resource consumption and their monitoring is considered as one of the information gaps in Tehran municipality. Almost more than 50% of the total national energy is consumed in the building sector, whether in the domestic sector, in the office sector, in the commercial sector or in the industrial sector. At the same time, more than 40% of Iran's buildings deviate from international standards. Article 19 (Energy Saving) of the National Building Regulations of Iran, which is the most basic issue of energy efficiency in the building sector, has been announced for more than 5 years, but has not yet been fully implemented and is not a major concern for the Ministry of Roads and Urban Development. In fact, the economic parameters are so influential in the housing sector in which the field of energy efficiency disappears (Fazli and Heydari 2013).

Energy Management refers to the regulation and optimization of the use of energy systems, which include engineering, control and managerial methods (Samavati 2016). Energy management should be connected to the organization's operational goals, not moving in a separate path (Shabanzadeh and Javan 2003). In this regard, building energy index (BEI) is defined as total energy of electricity consumed by the building ($kWh/m^2/yr$). Energy Consumption Optimization refers to the selection of patterns and implementation of energy consumption policies, which are desirable in terms of the national economy, guarantee the continuity and durability of energy, promote life indicators, reduce costs, and predispose the expansion of justice in society. In this framework, it is considered to use the most efficient way of using resources, which implies reducing the destruction of energy resources and also reducing the adverse effects of improper use of energy on the environment (Tatar and Marafet 2013).

In recent years, there have been many studies on optimizing energy consumption in Iran. In this context, Hesami (2020) explained the effectiveness of the implementation of the resolution to reform the pattern of energy and resource consumption in Tehran municipality buildings. The results of this study showed that the implementation of the mentioned plan reduced the consumption of energy and resources in two years (2018 – 2019). The project led to a 3% reduction in water consumption, 9% in electricity consumption and 5% in gas consumption per capita. In applied research, Mohrami et al. (2016) used some indicators to manage energy and environmental safety to present several projects in the field of smart buildings, energy efficiency and safety in sustainable development. Their hypotheses were aimed at preventing the harms that humans were not able to deal with due to due to mental preoccupations, lack of opportunity or human errors, thereby resulting in unwanted accidents. Khadivi et al. (2016) identified seven indicators affecting energy consumption in a 15-story high-rise office building in Tehran equipped with an energy management system and used Design Builder software to simulate the available data. The results showed that saving the energy of cooling and heating devices could reduce the annual energy consumption by 35 – 40%. In a study on smart buildings as an effective choice in energy efficiency through library studies, Hojjati et al. (2012) stated that Iran has the highest intensity of energy consumption in the world, with the highest amount (around 40%) in the non-productive sectors. Kazemi and Kazemi (2017) investigated the social inhibiting factors of energy consumption efficiency in office buildings in Iran. Samavati (2016) investigated the energy management of smart buildings with renewable energy sources and found that their proposed energy management algorithm saved about 28% of the electricity cost of buildings.

Salvia et al. (2021) investigated ways to promote policy making to improve energy efficiency in municipal public buildings. In this research, they focused on public policy making in the field of energy management. Their results indicated that technical, engineering and managerial aspects should be used in an integrated manner. Mariano-Hernandez et al. (2020) presented a model for energy management in office buildings. With the presupposition that building energy consumption is expected to increase up to 40% in the next 20 years, they claimed that electricity has the highest amount of energy consumption in buildings. Based on the results of this research, it was found that the strategies used for energy management in buildings vary according to the type of building and basically two strategy models can be adopted: residential and non-residential buildings. Chen et al. (2020) reviewed the factors affecting energy efficiency

Table 1. Components extracted from the literature and interviews affecting energy consumption management.

Functional dimensions	Components		References	Source of extraction	
	Descriptions	Abbreviation		Literature	Interview
Architecture and engineering	Applying smart building standards during design and construction	C1	• (Lu et al. 2018) • (Teng et al. 2018) • (Tavares et al. 2019) • (LEED 2016) • (Lee et al. 2014)	♦	♦
	Regularly checking and fixing defects of facilities and equipment	C2	• (GEF 2015) • (LEED 2016) • (Wang et al. 2019) • (Hang 2010)	♦	♦
	Achieving energy-related environmental standards	C3	• (LEED 2016) • (Zhao et al. 2011)	♦	♦
	Using appropriate technology for manufacture and providing and using low-consumption supplies and equipment	C4	• (Salvia et al. 2021) • (Pallante et al. 2020) • (Economidouk et al. 2020) • (LEED 2016) • (Tillie et al. 2009) • (Zhang et al. 2018) • (Hong et al. 2018) • (Ochoa et al. 2012)	♦	♦
Rules and regulations	Adopting renewable and green energy sources	C5	• (Economidouk et al. 2020) • (LEED 2016)	♦	♦
	Implementing green tax policy	C6	• (Tillie et al. 2009) • (NZGBC 2014)		♦
	Applying incentive/punishment mechanism	C7	• (Li et al. 2014)	♦	♦
	Planning and establishing rules and regulations	C8	• (Salvia et al. 2021) • (Sandmo 2006) • (Shadram et al. 2016) • (Wang et al. 2019)	♦	♦
Behavioral patterns	Saving cooling and heating energy	C9	• (Tillie et al. 2009) • (Edmund and Brown 2015) • (Malacarne et al. 2016) • (LEED 2016)	♦	♦
	Improving the motivations and behavioral empowerment of users and consumers	C10	• (Chen et al. 2020) • (Tillie et al. 2009) • (Rice 2006) • (Calero et al. 2018) • (Nilsson et al. 2018)	♦	♦

Matrix		C1 1	C2 2	C3 3	C4 4	C5 5	C6 6	C7 7	C8 8	C9 9	C10 10	normalized principal Eigenvector
C1	1	1	1/4	1/3	1/6	1/3	4	2	3	1/7	2	5.03%
C2	2	4	1	2	1/2	3	7	5	6	1/2	4	15.89%
C3	3	3	1/2	1	1/3	2	6	4	5	1/3	2	10.47%
C4	4	6	2	3	1	4	9	7	8	2	6	26.81%
C5	5	3	1/3	1/2	1/4	1	5	3	4	1/3	2	8.07%
C6	6	1/4	1/7	1/6	1/9	1/5	1	1/3	1/2	1/8	1/4	1.69%
C7	7	1/2	1/5	1/4	1/7	1/3	3	1	2	1/6	1/3	3.13%
C8	8	1/3	1/6	1/5	1/8	1/4	2	1/2	1	1/7	1/3	2.26%
C9	9	7	2	3	1/2	3	8	6	7	1	4	21.54%
C10	10	1/2	1/4	1/2	1/6	1/2	4	3	3	1/4	1	5.11%

Figure 1. Pairwise comparison matrix of 10 selected components (average votes of 32 experts).

in buildings, and their findings indicated three main internal and external categories, including building features, equipment and technology, and occupant's behaviors. The findings showed that using only one of the above three factors will not provide the possibility of achieving effectiveness in energy management. Based on several review studies, it has been determined that the energy consumption reduction rate in smart buildings will be around $10-28\%$ and $43-71\%$ in heating, ventilation and air conditioning (HVAC) and lighting systems, respectively. Pallante et al. (2020) concluded that the control of some variables would save an average of $10-28\%$ of energy costs. Economidouk et al. (2020) reviewed 50 years of European Union (EU) energy efficiency policies for buildings. The analysis of economic and environmental aspects showed that the EU has been promoting public energy efficiency since the 1970s by focusing on buildings, policies and special programs. These strategies have been gradually strengthened to fulfill the commitments of energy and climate policies and priorities.

Considering the importance of the topic under discussion, the purpose of the present study was to design and present an environmental management model with an emphasis on optimal energy consumption in office buildings of District 5 Municipality of Tehran, Iran.

2. Materials and methods

An integrated approach (including in-depth survey and semi-structured interviews with experts) was used to extract the management components affecting energy consumption in office buildings. To this end, a comprehensive review was conducted on various and valid national and international documents, reports, articles and projects. The most important approaches used in this sector were Rotterdam Energy Approach and Planning (REAP), Energy Information and Management System (EIMS) and Leadership in Energy and Environmental Design (LEED) (Khayatnezhad et al. 2023;

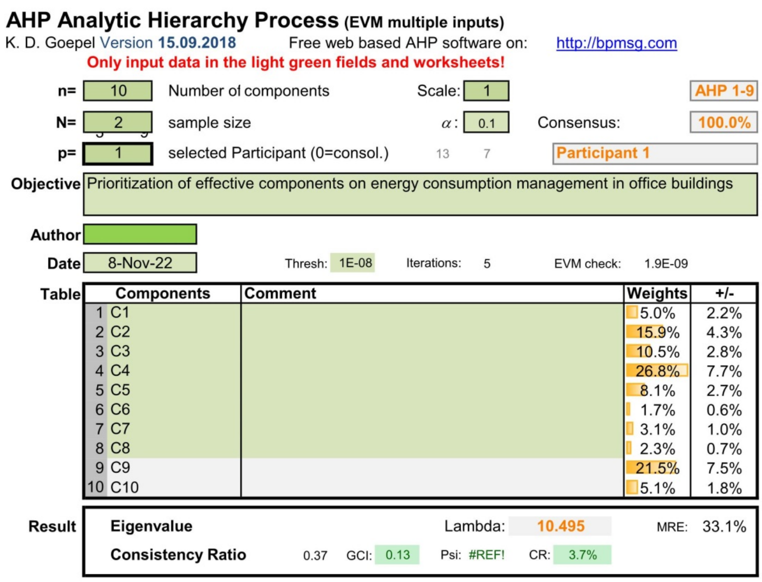

Figure 2. Comparison of the components affecting energy management in office buildings of Tehran municipality, Iran, based on the opinions of experts (n=32).

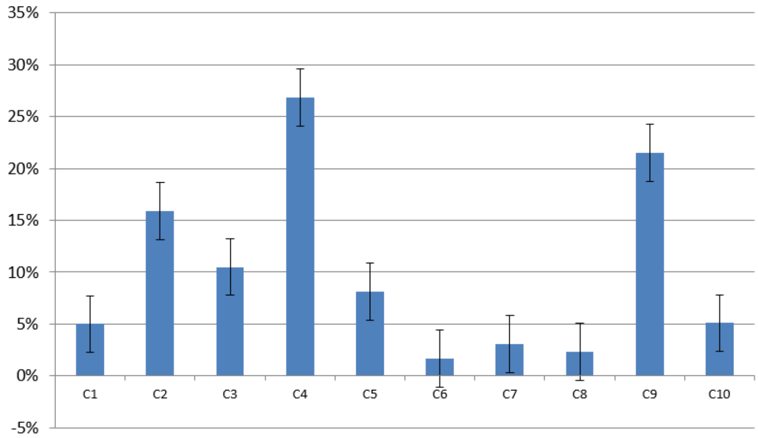

Figure 3. Comparison of the weight percent (w%) of selected components affecting energy management in office buildings of Tehran municipality, Iran, based on the opinions of experts (n=32).

Fataei 2014). In addition, the experts helped us in the form of a semi-structured interview to complete the items and extract the components. In this regard, the coding method was used to determine the components, as well as the analytic hierarchy process (AHP) and Expert Choice software, version 2004 under Excel (Excel version MS Excel 2013) were used for pairwise comparison and prioritization of components (Fataei et al. 2013). After designing the conceptual model, it was time to validate this model. To achieve this purpose, a researcher-made questionnaire was designed and distributed among statistical samples. The data obtained from the questionnaires were analyzed using quantitative methods and statistical techniques and became the basis for the validation of the designed conceptual model.

The proposed conceptual model was validated with the help of experts from scientific and specialized centers, institutions and organizations related to the environment, who were recognized as experts in the field of energy consumption management and met all the inclusion criteria, including a) having at least a master's degree in environmental or energy management, and b) being a faculty member of a university, research institute, or scientific and educational center with at least 15 years of related work experience and at least 5 years of related management or planning and decision-making experience. Since the present research was conducted in a specific organization and determined area, the sampling was done based on purposive sampling method, and finally the sample size was estimated to be 32 experts.

Validity was determined by convergent validity whose criterion is that average variance extracted (AVE) should be greater than 0.5, which is computed by Equation 1 (Habibi and Afridi 2022).

$$\mathrm{AVE} = \frac{\sum \lambda_i^2}{\sum \lambda_i^2 + \sum_i \mathrm{var}(\varepsilon_i)} \tag{1}$$

where, λ stands for factor loading and ε for error variance. In this research, the reliability of the questionnaire was investigated using composite reliability (CR) and Cronbach's alpha coefficients. Unlike Cronbach's alpha, which implicitly assumes the same weight for each index, the CR relies on the true factor loadings of each construct and provides a better measure of reliability. The CR should be more than 0.7 to indicate the internal stability of the structure (Fataei et al. 2013), whose coefficient is calculated as Equation 2:

$$\mathrm{CR} = \frac{\left(\sum_{i=1}^{n} \lambda_i\right)^2}{\left(\sum_{i=1}^{n} \lambda_i\right)^2 + \left(\sum_{i=1}^{n} \delta_i\right)} \tag{2}$$

Table 2. Results of Kolmogorov -Smirnov (K-S) test.

Components	Significance level	Test results
C1	0.079	Normal
C2	0.065	Normal
C3	0.113	Normal
C4	0.425	Normal
C5	0.098	Normal
C6	0.102	Normal
C7	0.053	Normal
C8	0.069	Normal
C9	0.107	Normal
C10	0.221	Normal

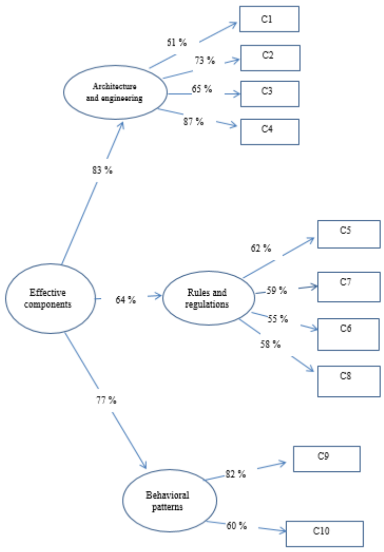

Figure 4. Measurement model of selected components affecting energy management in office buildings of Tehran municipality, Iran.

where, λ stands for factor loading and δ for error variance. The final questionnaire was evaluated for validity by AVE and for reliability by CR and Cronbach's alpha, the results of which indicated acceptable reliability and validity of the proposed questionnaire.
Adequacy of sample size was checked by Kaiser-Meyer-Olkin (KMO) and Bartlett's tests. The data were analyzed by confirmatory factor analysis (CFA) and the goodness of final model fit was done by structural equation modeling (SEM).

3. Results

The integrated strategy was used to obtain management factors and components affecting energy consumption in the studied office buildings using REAP, EIMS and LEED because of their comprehensiveness, accuracy, up -to -date and widespread application worldwide. Accordingly, 25 components were extracted initially based on in-depth survey and interview with experts. Then, they were screened and categorized by a stepwise coding process. In the following, 10 components were finalized, which were placed in three separate categories (architecture and engineering, rules and regulations, behavioral patterns) according to the functional scope and nature (Table 1).
Next, the above ten components were prioritized using pairwise comparison, as shown in Figure 1.
Figures 2 and 3 compare the weight percent (w%) of selected components affecting energy management in office buildings. As can be seen, the highest w% belonged to the C4 component (26.8%), followed by the C9 (21.5%) and C2 (15.9%) components, respectively, and the lowest w% belonged to the C6 component (1.7%).

3.1 Goodness-of-fit of the proposed model

Normality of data distribution was determined by Kolmogorov-Smirnov (K-S) test (H0: data distribution is normal, H1: data distribution is non-normal). The results of the K-S test (Table 2) showed that the distribution of all variables in the studied sample followed the normal distribution, because the significance level was more than 5% and the null hypothesis was not rejected. Therefore, one of the assumptions of the structural equation model was established, and the data had no severe skewness and kurtosis, and the distribution of variables was normal.
According to the test results, the KMO value was 0.623, so the sample size was adequate for CFA and SEM tests.

3.2 Results of confirmatory factor analysis (CFA)

To confirm the integrated model, 10 components (subsets of three dimensions) were used in the questionnaire. Based on the output of the software, the factor loadings of all components were higher than 0.4, indicating the appropriateness of the desired indicators. Model fit indices were used to make a decision regarding the confirmation or rejec-

Table 3. Fit indices to confirm the components of the integrated model.

Type of index	Absolute fit indices (AFI)		Incremental fit indices (IFI)			Parsimonious fit indices (PFI)	
	RMR	GFI	TLI	CFI	IFI	RMSEA	CMIN/DF
Standard values	0.08>	>0.9	>0.9	>0.9	>0.9	0.08>	1-5
Architecture and engineering	0.079	0.942	0.959	0.903	0.911	0.043	3.837
Behavioral patterns	0.073	0.941	0.929	0.949	0.953	0.076	2.144
Rules and regulations	0.061	0.901	0.901	0.899	0.919	0.047	1.636

Table 4. Strategies extracted from the Delphi panel and data quality assessment.

Code	Strategies	Data quality indices					Final weight
		DConf	DC	DU	DCon	DCom	
S1	Strengthening the national environmental policy system in the field of energy	4.89	3.60	4.11	3.35	3.80	3.95
S2	Placing and designing appropriate office buildings	4.73	3.52	4.03	3.11	3.72	3.823
S3	Strengthening the infrastructure and equipment in the field of energy consumption optimization	4.83	3.91	4.07	3.90	4.11	4.16
S4	Emphasizing the participation of employees and managers in energy consumption optimization	4.32	3.46	3.76	3.93	3.66	3.826
S5	Using green tax and incentive solutions in energy consumption	3.51	3.31	2.11	3.34	3.51	3.156
S6	Empowering employees regarding the environment	4.12	3.24	3.44	3.91	3.44	3.63
S7	Improving the insight and knowledge of managers towards the environment	4.75	3.00	3.15	3.83	3.15	3.576
S8	Allocating financial resources to use clean energy sources	4.66	3.79	3.99	4.22	3.99	4.13
S9	Developing aspects of engineering in the field of environment and energy	4.52	3.82	4.02	3.76	4.02	4.02

DConf: Data Conformity; DC: Data Currency; DU: Data Uniqueness; DCon: Data Consistency; DCom: Data Completeness.

tion of the measurement model. CFA seeks to confirm the goodness of fit of the model, or in other words, to confirm that the presented model is similar to the real model. The goodness of fit of the model was evaluated using indices including goodness of fit index (GFI), root mean square residual (RMR), Tucker-Lewis index (TLI), comparative fit index (CFI), incremental fit index (IFI), chi-square degree of freedom ratio (CMIN/DF) and root mean square error of approximation (RMSEA).

The GFI values for the integrated model were estimated to be 0.942 (for architecture and engineering), 0.941 (for behavioral patterns) and 0.901 (for rules and regulations), which were in the acceptable area due to being more than the standard value (0.9), as well as the RMR values were 0.079, 0.073 and 0.061, respectively, which were in the acceptable area due to being lower than the standard value (0.08). Moreover, the TLI values were 0.959, 0.929 and 0.901, the CFI values were 0.903, 0.949 and 0.899, and the IFI values were 0.911, 0.953 and 0.919, respectively, which were in the acceptable area due to being more than the standard value (0.9). In addition, the CMIN/DF values were between 1 and 5, so it was in the acceptable area. The RMSEA value was also less than 0.08, so it was in the acceptable area. Therefore, considering that at least three indicators had values in the acceptable range, it could be claimed that the fit of the model was good and acceptable. In other words, the results of the model fit tests showed that the 10 proposed components could be candidates in the majority of the model components.

The results showed that the dimensions “Architecture and engineering”, “Behavioral patterns” and “Rules and regulations” explained 76.74%, 42.88% and 32.72% of the variance of the model, respectively.

Hitt’s strategic planning model was used to develop strategies (Nodeh et al. 2021). For this purpose, the Delphi panel was requested to provide effective strategies regarding the identification and weighting of the effective components on the energy management model. Finally, all the extracted strategies were categorized and again provided to the experts for final approval to obtain the final summary. The results are as described in Table 4.

Figure 5 shows the comparative diagram of the importance and position of strategies. As can be seen, strategy S3 was ranked first with a final weight of 4.16, followed by strategy S8 (4.13). Strategy S5 was the last priority (3.156).

Table 5. Regression values of path estimation between model variables.

Paths	Estimate
Architecture and engineering solutions − − − > the main phenomenon (energy management)	0.81
Rule and regulation solutions − − − > the main phenomenon (energy management)	0.68
Behavioral pattern solutions − − − > main phenomenon (energy management)	0.77
The main phenomenon − − − > approach	0.88

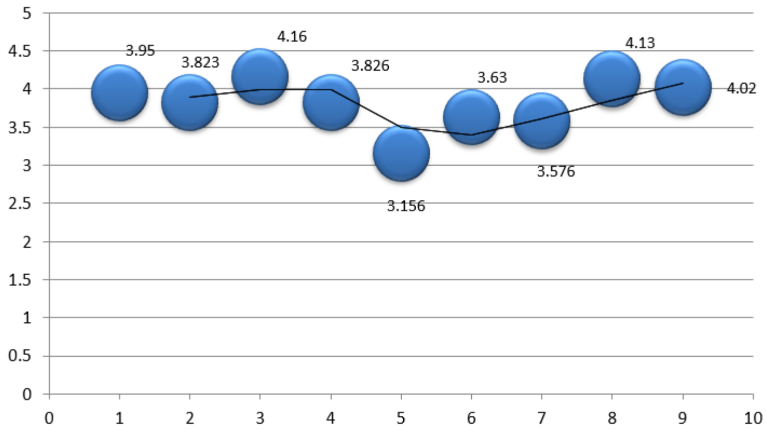

Figure 5. The final weight of strategies extracted from research findings.

3.3 The results of the structural equation modeling (SEM)

After ensuring the appropriateness of the model fit, the structural equation model was drawn following the research model based on the latest changes in confirmatory factor analysis. Due to the appropriateness of the model fit, there was no need to remove the markers in the model and also draw the covariance between the errors. Considering the purpose of implementing structural equations, which is to estimate the relationships between variables, Table 5 reports the regression values of all path estimates between model variables.

Based on the results of structural equations, the relationship between the two variables "solution" and "main phenomenon" was significant, so that the coefficient of "Architecture and engineering solutions" path to energy management was 0.81, indicating a positive relationship between these two variables. It meant that if the architecture and engineering sector increased by one unit (on the condition of keeping other factors constant), energy management would increase by 0.81 units. The coefficient of "Rule and regulation solutions" path to the main phenomenon (energy management) showed a positive relationship between these two variables. It meant that if there was an increase of one unit in the regulations and laws section (on the condition of keeping other factors constant), energy management would increase by 0.68 units. The coefficient of "Behavioral pattern solutions" path to the main phenomenon showed a positive relationship between these two variables. It meant that if the behavioral patterns section increased by one unit (on the condition of keeping other factors constant), energy management would increase by 0.77 units. Finally, the coefficient of the path "main phenomenon" to "approaches" showed that for one-unit increase in the main phenomenon variable, 0.88-unit increase in approaches would occur.

4. Discussion

The findings of our research were consistent with the results of previous researches (Hesami 2020; Mohrami et al. 2016), because these researches also emphasized the necessity and role of reducing energy consumption.

The factors affecting the reduction of energy consumption in office buildings can be considered in three dimensions, including (a) architecture and engineering, (b) rules and regulations, and (c) behavioral patterns. A total of 10 components related to the factors affecting energy consumption management in office buildings were extracted in our study. In this regard, Calero et al. (2018) reported seven effective components. The highest and lowest weight percentages were related to C4 ("Using appropriate technology for manufacture and providing and using low-consumption supplies and equipment", 26.8%) and C6 ("Implementing green tax policy"1.7%) components, respectively.

All data had a normal distribution; Considering the value of KMO index which was equal to 0.623, the sample size was sufficient for confirmatory factor analysis and structural equation modeling. As mentioned earlier, since at least three indicators (GFI, RMR, TLI, CFI, IFI, CMIN/DF and RMSEA) showed values in the acceptable range, it could be claimed that the fit of the model was good and acceptable. In other words, the results of the model fit tests underlined that the 10 proposed components could be candidates in most of the model components. According to the results, the main functional dimensions of "Architecture and engineering", "Behavioral patterns" and "Rules and regulations" could explain 76.74%, 42.88% and 32.72% of the variance of the model, respectively.

These results were in line with the findings of Hojjati et al. (2012) because they also expressed the importance of smart buildings and the application of engineering aspects to reduce energy consumption. Similarly, according to Ghazi and Naderi (2011), the use of energy management system reduces energy consumption and prevents the wastage of various resources used in cooling and heating sectors.

Regarding the strategies, the results showed that the strategy "Strengthening the infrastructure and equipment in the field of energy consumption optimization" with a final weight of 4.16 was the first priority, and the strategy "Allocating financial resources to use clean energy sources" was ranked next (4.13). The strategy "Using green tax and incentive solutions in energy consumption" was the last priority (3.156). Some of the strategies presented in this research were consistent with the study of Kazemi and Kazemi (2017); they also came to the conclusion that planning is the most important key in energy management, and the use of advanced technology and high investment but without management can lead to wasting the organization's resources.

5. Conclusion

According to the findings of the present research, the components affecting the environmental management of the office buildings of Tehran municipality in Iran from the point of view of saving energy consumption were determined to be 10 components included in three functional dimensions. It is hoped that the use of solutions derived from the developed strategies can be positive in energy management. The research results made the following suggestions:

- Implementing effective laws and regulations related to the field of energy consumption for office buildings;
- Using environmental management solutions with an emphasis on energy management in the office building (study site) using a movable smart canopy, installing photovoltaic panels and optimal combined mode;
- Periodically and regularly monitoring government buildings from the point of view of energy management;
- Observing environmental considerations when designing and placing government office buildings;
- Using the principles of engineering in design and construction;
- Applying modern technology regarding energy management;
- Improving managers' insight and knowledge about energy and environmental management and holding related training courses;
- Granting certificate of occupancy to office buildings subject to obtaining and implementing energy standards;
- Promoting appropriate training, interest and motivation among users regarding energy management in office buildings in order to implement environmental programs based on energy management with the participation of employees with appropriate efficiency.

Conflict of interest statement

The authors declare that they have no conflict of interest.

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