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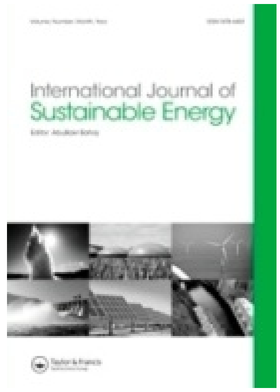

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Policies on sustainability of buildings have been progressively gaining importance throughout the world. Turkey is a part of such international movements and is now striving to address its energy performance, by reducing emissions of contaminants derived from energy consumption of buildings, and through the protection of the environment. The present paper links these two elements of development, through the revision of building policies and strategies that take place in Turkey while contextualising worldwide sustainability targets and key trends. This is demonstrated with the aim of identifying the environment and energy goals that underpin the construction sector. As a result, specific actions, regarding policy and implementation arise. These could enable the reduction of energy usage and emission of pollutants, partially through the increase of renewable energy use and the promotion of building certification, as dictated by existing legislation.

Keywords: sustainable buildings; sustainable building policies; sustainable building strategies; energy policies; Turkey

Introduction

The building sector has become the largest sector responsible for world energy consumption and carbon dioxide (CO_2) emissions (IEA, 2019b). This is due to the inability of the building sector to keep up with other sectors in developing and enforcing sustainable methods, procedures and technologies. In developed countries, buildings have become a priority for achieving energy efficiency due to their longevity, energy consumption levels, and the number of technological products and services developed under older environmental frameworks. Therefore, sustainable construction has become a primary focus across scientific communities who try to address sustainable development goals. In parallel, building policy-makers produce legislation towards increasing energy efficiency whilst also minimising environmental impacts. Recent evidence shows that the total energy use generated across construction industries reached 36% of global final energy use in 2018. This includes energy use during construction and operation. Furthermore, the sector is responsible for almost 40% of the world's CO_2 emissions (IEA, 2019b).

In line with the above, improving energy efficiency is widely seen as a relatively inexpensive way to decrease total energy consumption through its carbon dioxide (CO_2) emissions (Azhar Khan, Zahir Khan, Zaman, & Naz, 2014). To further best practices in the use of buildings, well-thought design standards and regulations need strict enforcement at the time that relevant technical and technological developments emerge and are integrated (Iwaro & Mwasha, 2010). Although international communities set conditions for generating procedures and policies, different countries enforce these at different levels, hence actions are taken regionally as opposed to globally (Al-Tamimi, 2017). As a result, nearly two-thirds of all countries do not have a building energy code yet (IEA, 2019a). Those gaps have led some to believe that efficiency building codes exist only on paper, particularly across developing countries (Deringer, Iyer, & Yu Joe Huang, 2004). Evidently, there is no unique global perspective regarding how sustainable development can be realised with the best practices. The fact that various sustainability perspectives exist reflects the referred global asymmetries. Examples of the various sustainability frameworks include those formulated by countries affiliated to the Organisation for Economic Co-operation and Development (OECD), United Nations Framework Convention on Climate Change (UNFCCC), Kyoto Protocol, International Energy Agency (IEA), and United Nations Environment Programme (UNEP). With the understanding that a more sustainable and clean environment for everyone requires higher levels of engagement from all stakeholders, the European Commission is taking a leading role, reaching wider audiences promoting the creation of medium to long-term strategies or policy objectives that fulfil well-established energy standards for practical use (IEA, 2019a). These would include the ISO (International Organization for Standardization), IECC (International Energy Conservation Code), ASHRAE (American Society of Heating Refrigerating and Air Conditioning Engineering), CEN (European Committee for Standardisation) standards, Nationally Determined Contributions (NDCs) under Paris Agreement, standards, and the European Energy Performance in Buildings Directive (EPBD), to cite but a few. These efforts have captured attention from countries such as Turkey, which strives to develop legislation and operational infrastructure, enforce national energy performance regulations, institute green building standards, and begins creating financial incentives for those involved in the development of built environments to adopt the best practices.

A few studies have addressed energy policies on buildings in Turkey (Elsland, Divrak, Fleiter, & Wietschel, 2014; Evans, Yu, Staniszewski, Jin, & Denysenko, 2018); however, these studies have not extensively explored and assessed present laws, regulations, and strategies on buildings from a sustainability perspective. This paper is therefore concerned with the critical assessment of regulations that support the sustainable performance of buildings in Turkey from the energy, environmental and design perspectives including their correlation with practices around the world. The following discussion firstly scrutinises globally established policy and strategic actions.

It follows an overlook on current measures on sustainability, in Turkey and beyond, to later focus on the evaluation of state policies and goals set to achieve sustainability goals generated through international agreements. The investigation concludes with an overall assessment of actions and improvements achieved so far in Turkey.

Policy and Strategy Actions on Sustainability of Buildings at a Global Level

Policy Actions

Countries are in a continuous improvement and renewal process regarding sustainability policies. Building certifications and legislation on the sustainability of buildings mostly includes energy efficiency and environmental impacts. To date, building energy codes are in use across 69 countries. This also means that energy codes do not exist in approximately 2/3 of the countries worldwide (IEA, 2018). The term building energy code is generic for what countries call *energy efficiency building code, thermal building regulation, or energy standards of buildings* (Nejat, Jomehzadeh, Taheri, Gohari, & Muhd, 2015). These codes have different levels of enforcement widely ranging between mandatory and voluntary (Iwaro & Mwasha, 2010). Mandatory standards are common in European countries, and also Russia, Turkey, Japan, China and Australia whereas code enforcement is partial in countries like India, Ukraine, Iran, Argentina and Mexico (IEA, 2018). Overall, European countries hold the highest proportion of mandatory energy standards whereas Latin America, Africa and the Middle East concentrate the lowest proportion of the available energy codes. Asian countries have a mix between mandatory, voluntary, and no code enforcement. According to Iwaro (2010), building codes can be mandatory or voluntary for new and/or existing buildings but in some countries, the term 'mandatory' just applies to the new building. The level of stringency in law enforcement, therefore, varies from country to country. According to Berardi

(2015), energy policies of developing countries have only been established recently, while developed countries have relatively more advanced policies in comparison.

It is recorded that over the period 2000 to 2017 and beyond there has been a continuous increase in the number of practices adopted promoting efficiency worldwide. This figure passed from 38% in 2017 to nearly 40% in 2018. As seen in Figure 1, lighting has a larger share globally in mandatory policy coverage than space cooling/heating, water heating and appliances (IEA, 2019a). However, many countries fall behind in their implementation of energy policies, which directly affects the growing building stock in those regions.

Since around 1990, energy efficiency is enforced with tools such as BREEAM and LEED certifications - these are the most commonly used building certification systems in Turkey (Aktas & Ozorhon, 2015). These accomplish three key steps: assessing, rating and certifying. Currently, 85 countries are certifying buildings energy performance; however, most of these certifying processes are not mandatory (IEA, 2018). As of 2020 in Turkey, energy performance certification became mandatory for buildings built after 2011.

Throughout the world, as in Turkey, building certification procedures and focuses update regularly. Those procedures are driven by energy performance and optimisation as covered by 2010/31/EU European Energy Performance of Buildings Directive (EPBD) (EPBD, 2010). The main policy drivers affecting the building sector and energy efficiency practices in the European Union (EU) are energy-, climate-and product-oriented (ATCMP, 2014). In addition, the EPBD (2010) energy performance certification is mandatory when selling and renting buildings. Such policies manifest themselves in different forms in member states. For example in Germany, the state that arguably stands as environmentally "stricter" within the European community (Nejat et al., 2015), building energy codes abide by the Energy Saving Art (EnEG) and the Energy Ordinance (EnEV) for minimum energy performance in buildings and certification. As for product-orientated policies, in 2016 requirements were brought by 25% and 20 %, respectively for improvements on energy-saving and insulation of new buildings. Such policies enabled a 75% improvement in energy savings from heating in Germany since 1975 (IEA, 2018). Rather less direct methods take place in Denmark and Portugal, where certifications are issued by independent reviewers, although some good practice arises when noting that buildings' energy efficiency must be justified before construction (Laustsen, 2008). Notwithstanding differences with Germany in terms of approaches, Denmark is perhaps the most successful European leader enforcing the zero energy target buildings (Zhang, Zhou, Hinge, Feng, & Zhang, 2016). An example of this is the 27% reduction in their total greenhouse emissions achieved between 1990 and 2015 (DEA, 2017). Building on those examples, France certified 500 000 and 800 000 housing units with "High Quality Environmental" (HQE) standard and "EFFINERGY", respectively, also certifying 50 000 house unit with "NF habitat HQE" annually (IEA, 2018). In the EU, long-term energy renovation for existing buildings is encouraging to achieve nearly zero energy building stock by 2050 revised in EPBD, recently (EPBD, 2018). Up to now, these renovations via energy retrofitting have provided significant benefits to the world, resulting in 50-90% energy savings. Besides the energy retrofitting of buildings, structural retrofitting in seismic prone areas of the EU is also considered by incorporating it alongside other sustainability measures (Lucon & Ürge-Vorsatz, 2014).

The Asian continent is also proactive in enforcing developments of sustainable infrastructure. South Korea uses a building energy efficiency rating system mapped from the Green Building Act, the Green Building Certification system and financial incentives (Koo, Hong, Lee, & Seon Park, 2014; Nejat et al., 2015). China implemented energy efficiency standards tailored to different climates (Laustsen, 2008). Likewise, for the most prominent European countries, the building energy code is compulsory. Since 1996, China has issued numerous guidelines and legislation on green buildings to finally issue its first national green building standard in 2006 (Geng, Dong, Xue, & Fu, 2012). Currently, green building labelling is voluntary. Should construction companies fail to comply with these mandatory requirements; they would have to pay between 2% and 4% of the contract price as a penalty (Li & Shui, 2015). Despite the increased floor area and electrical appliances that result from rapid urbanization and population, China has the potential to reduce its energy consumption to 54% (ATCMP, 2014). In Japan, the first energy law set in 1979 states that when the built surface is greater than $2000m^2$ compliance energy use should be strictly checked against the relevant standards. Additionally, in 2012 the Innovative Strategy for Energy and the Environment (ISEE) established a road map to guide urban developers. This relatively new policy became mandatory by 2010, detailing for every building type to determine energy performance (IEA, 2013a). Hence, their Comprehensive Assessment System for Building Environmental Efficiency (CASBEE) will absorb the Green Building Rating System (Laustsen, 2008). The Japanese government also encourages voluntary labelling as per building energy performances. This is done through a programme called Top Runner, which also provides guidance on the use of technology for achieving high-energy performance (Kimura, 2010). Japan also integrated its building energy code with building structural performance code in its building certification (IEA, 2018).

In North America, energy efficiency is promoted through the International Energy Conservation Code 2004 (IECC), guidance provided by the ASHRAE, and the Canadian National Building (Nejat et al., 2015). These countries also provide tax incentives to encourage the best practices amongst constructors (Laustsen, 2008). The USA takes further actions to support sustainability in the built environment such as technological developments and renovations for government building and low-income housing, in addition to a voluntary labelling and investments scheme (IEA, 2013b). Their building energy performance plan ENERGY STAR strengthens capacity by enabling energy savings on the order of 20% (Nejat et al., 2015). As a result, they achieved a decrease in energy intensity of 19% and 15% in residential and commercial buildings, respectively between 2007and 2017 (Leung, 2018). Canada upgraded ENERGY STAR procedures for Ontario new homes and energy efficiency requirements to 20% in 2017 (IEA, 2018). In addition, they upgraded the performance standards of energy appliances in 20 categories in 2016 (IEA, 2017b). Joining the region initially through NAFTA, Mexico started to adopt local codes and building energy performance tools, and it has been applied to 230 000 buildings in the last three years (IEA, 2018).

Most of the energy code policies focus on the building envelope (IEA, 2017b). However, heating and cooling of buildings also need to be considered. One of the reasons for this is that the energy demand for building cooling is to triple by 2050 if the current policies do not change. In contrast, energy investments in buildings are decreasing, that fell from 11% in 2016 to 4.7% in 2017 (IEA, 2018).

Strategy Actions

Specific energy and emission targets on buildings are essential to produce more effective and strict building sustainability policies. It is a general fact that the level of policy enforcement varies across countries. Local targets address local requirements, which naturally differ from international practices (Deringer et al., 2004). Table 1 shows examples of country-specific targets around the world, under four headings: energy saving, emissions reduction, renewable energy sources and nearly zero energy.

The table is differentiated from the general strategies that countries created on sustainability and consists of strategies targeting only of the building sector.

Most targets clearly rely on reducing energy consumption from buildings. Renewable energy is seen as imperative in energy-saving goals (EPBD, 2018). In addition to that, technological clean energy solutions with low-carbon power generation can potentially reduce CO_2 emissions by nearly 90% by 2050 in the world (IEA, 2019c). For example, solar power technology has the potential to supply carbon-free heat to about 3 billion people by 2050 in the world (IEA, 2019c). This reduction in energy consumption is critical to achieving the goal of the Intergovernmental Panel on Climate Change (IPCC) to reduce the planet's carbon footprint by 77% by 2050 (Keskin, 2010).

Developed countries started developing city-specific targets towards more efficient use of energy in buildings. For example, Van Couver, Canada introduced a Zero Emissions Building Plan, which aims at improving education in construction. Overall, 18 cities in the world set regional targets. Their objectives include achieving net zero carbon by 2030 while enforcing 100% electricity supply from renewables by 2035 (IEA, 2018). It is believed that better construction practices have the potential to decrease energy consumption worldwide by almost 30% by 2050 (IEA, 2019c).

Examples of the impact of having implemented ambitious targets include EU decarbonisation and nearly zero energy, which enabled reducing energy consumption at above 2%/year across some EU countries (Romania, Poland and Estonia households) (Berardi, 2015). The challenges to achieving global targets, however, remain. The global average building energy use per person needs to pass from 5 MWh to 4.5 MWh to meet global temperature raising below the 2^0C target by 2025 according to the IEA, which is equivalent to 30% improvement in energy intensity per square meter of the built floor area (IEA, 2017b). These targets are set out as a global action plan in the 2015 Paris Climate Conference (COP21) (IEA, 2017c).

Turkey Landscape of Buildings' Sustainability

Energy underpins production, and world energy production and consumption are increasing with investments towards industrialisation. In Turkey, although, energy consumption has decreased in the building sector between 2012 and 2014, buildings had the largest share of the sectoral energy consumption in the same period with 34%, which account for 30 Ktoe, as seen in Figure 2 (MENR, 2016b). Following, in 2015, 24.8% of primary energy supply was provided to the building sector (MENR, 2016a), which was the second-largest share compared to other sectors. On the global scale, although energy usage from buildings is decreasing, buildings have the biggest share of energy consumption. Between 2015 and 2018, the speed of decrease in energy intensity in the building sector has fallen from 2% to 0.6% (IEA, 2019a). Despite the downward trend in energy, if adequate measures are not taken, the energy demand in the building sector will reach 50% by 2050 globally (IEA, 2013b). Furthermore, in Turkey, 18% of carbon dioxide emissions derive from the building sector (ATCMP, 2014), whereas Figure 2 shows that emissions caused by building sector nearly doubled in 10 years, and reached almost 53 million tons of CO_2 by 2014. Regarding the residential sector, between 2015 and 2017, fuel-related carbon emissions increased to 32% (TSI, 2019). As highlighted above, the building sector has great potential for emission and energy savings. The first national statement submitted to the UNFCCC concluded that investment in energy efficiency for emission reduction is more cost-effective than implementing renewable energy technologies (Keskin, 2010). The potential for energy saving in residential and commercial buildings are 46% and 20%, respectively (ATCMP, 2014).

Factors that can influence the sustainability of buildings include energy supplies for space heating or cooling devices, architectural or structural components (materials), and mechanical systems (for lighting, water heating, etc.). Attenuating factors account for the increase of population; hence the volume of building stock and the sophistication of mechanical and digital systems that facilitate building management also increase. These rise energy consumption at a rate of around 3% annually worldwide and is seemingly going to continue in the foreseeable future (IEA, 2019b). In 2010, the breakdown of energy consumption in Turkey, considering space heating, water heating, cooking and appliances was 43%, 26%, 10% and 21% respectively (Toklu, Güney, Işık, Comaklı, & Kaygusuz, 2010).

Turkey is importing energy from neighbouring countries to cope with the internal energy demand. Its dependence on external sources makes this country the sixth-largest dry natural gas importer (EIA, 2019) while nearly 75% of all imported resources go to non-domestic activities. To mitigate this, the country put effort into establishing nuclear energy plants whose construction is due to start in 2023 (MENR, 2019).

Notably, more than one-third of the energy in Turkey is spent on heating and cooling (Keskin, 2010) while, limited to the built environment, 75% of the building's energy is spent on heating (World Bank, 2010). Until 2014, natural gas and coal products represented respectively 32.3% and 32.2% of the total consumption allocated to the heating of Turkish buildings (TSI, 2016c).

In 2017, natural gas energy demand for construction sector raised to 44%, as seen in Figure 3 (MENR, 2017). On the other side of the spectrum, Turkey has significant potential for generating renewable energy. As an example of this, nearly 1% of the world's total hydropower and high wind power can be developed in this country

(Toklu et al., 2010). According to Toklu (2010), an increase in geothermal, solar thermal and hydropower energy use are observed since 1990; however, because of its high potential, Turkey also needs to increase its solar and wind energy harvesting. This country registered an installed capacity of 40% for generating renewable energy, from where electricity generation totalled 29% in 2013 (NREAP, 2014). A projection made in 2009 suggested that the building sector had a potential saving of 7.1 Mtoe (EC, 2015).

Population Growth and Building Stock in Turkey

Population and the rapid pace of urbanisation are the critical drivers for demands in energy and resources. Turkey's population reached nearly 80 million by the end of 2016, and the population density increased to 104 people per square kilometre (TSI, 2016b). According to the Turkish Statistical Institute (TSI), the population by 2023 and 2050 will be of 84 and 93 million nationwide (TSI, 2013). Turkey's rapidly growing population transforms the building stock. To date, there are 9.1 million buildings in the country, from which approximately 87% are residential (NEEAP, 2018). However, that figure is unstable. Each year more than 100,000 new building is added to the building stock, see figure 4, (NEEAP, 2018) while, according to Turkish Standard Institute (TSI) (2017), 92.4% of these dwellings owned by the private sector, and 20.9% of them located in Istanbul. According to TSI data, more than 100km^2 floor area is adding every year, and this rate is gradually increasing, as seen in figure 4. Similarly worldwide, because of this rapid construction, 230 000 km^2 are expected to be occupied by new construction sites after over 40 years (IEA, 2017b).

The potential for the occurrence of earthquakes in the region imposes additional constraints to Turkish building developments. Earthquake regions of high seismic activity include 72% of the population, occupying 66% of existing dwellings (Ergunay, 2007). In Istanbul alone (with its 400 neighbourhoods), more than one million buildings need to be demolished or strengthened (Gibson & Goksin, 2016). According to Gurlesel (2012), the urbanisation rate will reach 84% in 2023. Alongside this, the building stock will increase to 25.56 million from 22 million in January 2016, and Turkey's total demand of housing stock (housing to be newly built) will amount 7.56 million units (with minimum C energy class) for the 12 years between 2012 and 2023 (Gurlesel, 2012). This increase would translate into a surge in demand for energy and emphasises the importance of energy-saving measures, especially in residential buildings. Existing buildings, therefore, need upgrading while new buildings need to abide by modern design standards (NEEAP, 2018).

The biggest problem of housing in the country, as recorded by TSI (2016a) in 2015, is heating inefficiency due to poor insulation, decay in the floors and frames, humid walls, floors and foundations, and insufficient daylight. Those problems affect 43%, 39%, and 20.6% of dwellings, respectively. The solution to such issues would include various factors, such as enhancing the capacity of the heat insulation domestic market, that is currently about 1.25 billion USD and unable to insulate more than 400 000 average houses per year (EESP, 2012). Besides mechanical and physical improvements in buildings, the impact of building materials should also take into account for construction in rapidly growing countries. Production of building materials is responsible for 20% of world’s fuel consumption (Dixit, Fernández-Solís, Lavy, & Culp, 2010) and nearly 18% of emissions for any construction project (Ibn-Mohammed, Greenough, Taylor, Ozawa-Meida, & Acquaye, 2013).

Turkey's Present Policy and Strategy Actions on Sustainability of Buildings

Policy Actions in Turkey

The section addresses actions towards sustainability in Turkey via *policy* linked to building regulations and law. Turkey is trying to keep pace with cutting-edge international developments to issue building energy regulations and guidelines. These would enable the optimisation of the use of devices to manage energy, at the time of providing incentives such as tax credits for the planning and development of dwellings. These innovations underpin the zero energy target set for urban development (NCCAP, 2011). The first regulation for reducing heat losses and gains in building refers to the Standard of Thermal Insulation Requirements (TS 825), first known in 1970 and revised in 1981, 1985, and in 1998. The Thermal Insulation Regulations of The Buildings superseded previous norms from 2000 (RTOG, 2000b). Turkish authorities labelled the new regulatory framework as *mandatory* and defined a remit that covers infrastructure built after 2000. A feature of the norm relates to the ambitious target of reducing by 50% heat losses permeating through façades (Keskin, 2010). Linked to that, the Turkish Heat Requirement Identification Certificate became compulsory for constructions since 2008 (RTOG, 2008a). The Energy Performance Building Regulation (EPBR) published in 2008, it became an additional instrument to mitigate energy loss in buildings of Turkey (RTOG, 2008b). EPBR derives from the Energy Performance of Building Directive 2002/91/EC formulated by the European Union for optimising the use of primary energy and limit CO_2 emissions (BEP, 2019). It is also a target of EPBR and for the Regulation on Improving Efficiency in the Use of Resources and Energy (RIEURR), to minimise heat loss with thermal insulation (RTOG, 2008c, 2008b). These provide detailed guidance to achieve sustainability targets, for example, by making mandatory the use of double-glazing with heat control/coating and prevention of air leakage from windows as well as the implementation of revolving doors and double doors in public buildings (RTOG, 2008c). Architectural solutions that considering meteorological data for preventing unwanted heat gains and losses and unwanted solar gains in summer also included in EPBR (RTOG, 2008b). According to projections, nearly 2 billion dollars could be saved out of 500,000 buildings designed according to modern regulations (Toklu et al., 2010).

Energy Efficiency Law first proclaimed in 2007. That legal instrument obliged the monitoring of energy performance in industrial establishments and buildings that later became the primary source of further technological developments (RTOG, 2007). The framework aims at saving a minimum of 15% of energy use in public buildings that have 250 TEP annual energy consumption and above or 1000m^2 total construction area and above. Later this target revised to at least 20% reduction overall, compared to 2010 (RTOG, 2011).

The regulatory framework proposed by EPBR later progressed into IT tools for the use of energy identification and certification (RTOG, 2008b) such as the National Energy Performance Certification Software BEP-TR adopted by the Turkish government, which enables assessing the energy performance of buildings of uses varied: residential, office, hotels, shopping, educational, commercial and health care. Furthermore, elements of EPBR fed into the Energy Efficiency Law formulated in 2007, which is including the minimum energy requirement for electrical devices (RTOG, 2007). In 2010, the Building Energy Performance National Calculation Method first appeared to the public. This law defines how to quantify energy consumption related to building heating, cooling, ventilation, lighting and hot water supply (RTOG, 2010b). It also sets direction about ways to evaluate energy efficiency addressing all parameters affecting the building's energy consumption, according to an energy performance classification.

The analysis above highlight examples where policy and law inevitably merge. These enforcements are particularly evident when it comes to certification. Regulations on certification of sustainable green buildings and settlements are also available as (RTOG, 2014) and (RTOG, 2017b). TSI and related non-governmental organisations are working to establish a standard for green buildings, which are becoming increasingly popular in the local construction sector (NREAP, 2014). During a transition period, the green certificate is voluntary to have (RTOG, 2017b).

The Turkish certification programme is, in various forms, based on labelling systems. An example of that is the Energy Identification Certificate (EIC). In that scheme, A and G identify the highest and lowest energy consumption level, respectively (RTOG, 2010b). The way it works is as follows; energy performance amounts compare against target annual energy consumption per m^2 of construction and associated CO_2 emissions (BEP, 2019). Specific procedures to work out comparison against benchmarks appear on the EIC while referring users to the BEP-TR nationally adopted tool. The metrics for quantification also include the use of renewable energy - incorporating, for example, building orientation, heat insulation, passive heating and cooling, and the use of daylighting and natural ventilation (RTOG, 2008b, 2010b). To facilitate the interpretation of the norm while enabling working out quantifications, transparent methodologies to determine the energy performance class of the subject building appeared published in 2010 (RTOG, 2010b). Its reviewed versions, issued in 2010 and 2017, also disseminated (RTOG, 2010a, 2017a). There are barriers and enablers to that movement. The latter includes the revised regulation of EPBR that delayed until 2020 certifications for buying, selling and renting. While new buildings and existing buildings built after 2011 have to categorise with a C label, older buildings do not have a labelling requirement at all (RTOG, 2010a). Enablers take the form of ministerial supervision of activity related to EIC while revisions of the normative framework take place in parallel to EU oncoming regulations (EESP, 2012), such as, (RTOG, 2014), (RTOG, 2017a) and (RTOG, 2017b).

The current framework on sustainability regulatory for buildings is examined under eight-building design practices and shows in Table 2. The change in these building design practices between 2000 and 2018 illustrates in Figure 5. Regarding space heating, several regulations have included this practice as a priority, as seen in Figure 5. According to Toklu (2010), the building sector causes a considerable amount of energy losses, particularly in space heating, afterwards water heating and cooking in Turkey. Regulations, such as; (RTOG, 2000a) and (RTOG, 2008b), widely promote the use of automatic control devices for fuel-saving and heating insulation. Furthermore, EPBR recommends steam mechanisms for water heating (RTOG, 2008b) or solar energy (RTOG, 2017a). According to this, after January 2020, having a central water heating system plan fuelled with solar energy is to become mandatory for non-residential buildings that have more than 1000 m^2 floor area (RTOG, 2017a).

Therefore, in Turkey new buildings with the central heating system must use central or local heat or temperature control devices and systems that share heating costs depending on the amount of heat usage (RTOG, 2000a). Thereafter, heating control devices became mandatory in central heating buildings in 2007 to reinforce that (RTOG, 2007). According to EPBR(2008b), automatic control system became compulsory for fuel and gas boiler for fuel-saving, and condensing heating devices is obligated for individual gas heating buildings in 2008. In 2010, the central heating application became obligated for new buildings with more than 2000m2 useful area (RTOG, 2010a).

On the other side of the spectrum, we have space cooling, which is on higher demand by the increase in outdoor temperatures seen recently over the summer. As a result, cooling spaces now costs 3- 6 times more than space heating (Keskin, 2010). The item, therefore, appears on the regulations regarding ventilation (RTOG, 2000b, 2008a). For public buildings, specific regulations there exist to address air conditioning, class and temperature setting (RTOG, 2008c, 2011), and central cooling designs have to be in place for non-residential buildings whose energy demand exceeds 250Kw (RTOG, 2010a).

In Turkey, polices on lighting differ from world trends. As seen in Figure 5, a limited number of regulations advice on this practice. Notwithstanding, from 2008, it is compulsory in the country to use high-efficiency fluorescent and LED lamps in public buildings. Building administrators should also use sensor control and automatic daylight control system (RTOG, 2008c). Furthermore, EPBR (2008b) advises on the use of sensors lamps, promotes inducing solar power and optimise the use of daylight. This branches out to daylight photoelectric switches and ultra-controlled remote-control switches.

Energy Labels for Households Appliances accelerated the transformation of white appliances to A and over labelled devices. To keep the change going, RIEURR (2008c) obliged Energy Star labelling of computers and similar devices in public buildings (RTOG, 2011). This efficient transformation of electrical devices reinforced with procedures on ecological profiles and environmentally friendly designs of products (RTOG, 2010c). The enforcement widened when EPBR included the use of automatic systems and central control systems for managing of air-conditioning and cooling.

Furthermore, computer-controlled building automation is now mandatory for facilities whose total built area exceeds 10.000m^2. RIEURR (2008c) also promotes the use of commercially available high-energy household appliances, primarily air conditioners, refrigerators, lamps, and bulbs (RTOG, 2011).

In recent years, legislation for increasing the share of renewable sources in the building sector, increased. According to EPBR (2008b), ways to produce renewable energy should explore for buildings with usage area above 1000m^2. The regulation advises developing alternative architectural solutions for buildings of this kind to have local renewable sources in their locality. In the design stage, developers of new buildings that have more than 20.000m^2 area should analyse renewable energy systems for heating, cooling, ventilation, water heating, electricity and lighting to upgrade the investment on green energy solutions to a minimum of 10% of the total cost of the building (RTOG, 2010a). In addition to that, the Law on the Transformation of Natural Disaster Risk Areas contains provisions on the restructuring and reconstruction of urban areas at risk of natural disasters. This arrangement offers a considerable opportunity for increasing the use of renewable energy and energy efficiency in the urban transformation areas under risk of disaster (NREAP, 2014).

Disseminating progress across stakeholders is also important. To that end, training programmes for building owners and employees there exist, for more efficient use of energy (RTOG, 2008b). The EIP (Efficiency Increasing Project) initiative is now under preparation for implementing measures to eliminate energy wastes, losses and uncertainties in buildings and industrial enterprises. Other initiatives include conducting Energy Manager_Training Programs and authorising Energy Efficiency Consultancy companies. Energy manager's duties and responsibilities now reflect in several pieces of legislation (RTOG, 2008c), (RTOG, 2008d) and (RTOG, 2011). As an example of the way this articulates, schools affiliated to the Ministry of National Education and buildings - affiliated to the general directorate of the Ministry of Energy and Natural Resources, toned to appoint energy managers to increase efficiency in the use of energy (RTOG, 2009, 2011). Also, within the framework of the Energy Efficiency Law (RTOG, 2007), there are requirements for the appointment of an energy manager for the buildings, the introduction of an energy identity certificate for buildings, and the determination of minimum performance requirements for electrical devices (RTOG, 2007).

Strategy Actions in Turkey

The first nationwide institution fomenting sustainable infrastructure developments was the Environmentally Friendly Green Building Council (Cedbik) established in 2007. The short to medium-term council strategic plan included an initial assessment to identify enablers and barriers for implementing energy-saving guidelines and policies. In addition to that recently, B.E.S.T. Housing certification system has created, which is appropriate for Turkey conditions, to implement in new housing projects (Cedbik, 2017).

This country is a member of The United Nations Framework Convention on Climate Change (UNFCCC). It takes part in international efforts for reducing greenhouse gas emission, adaptation to climate change and mitigation to global warming (MFA, 2019). The international collaboration has also been reflected in the 2012 National Climate Change Action Plan, underpinned by the National Climate Change Plan 2011-2023, which followed the UNFCCC meeting that year (NCCAP, 2011). Turkey's internal and external affairs have crystallised in a project for improving sustainability in new and existing buildings, following EU norms and EPBR regulation. Table 3 shows specific targets per strategic initiative(s) nationwide.

In 2012, limitations and sanctions to those overruling regulations regarding the efficiently use of energy and natural resources, CO_2 emissions, clean energy production, commercialisation of products and technology that mitigates damages to the environment, were established via the Energy Efficiency Strategy Paper (EESP) (EESP, 2012). Those strategy actions were reinforced by the National Renewable Energy Action Plan (2013-2023) (NREAP) while informed by the 2009/28/EC European Parliament Directive in 2014 (NREAP, 2014), as well as by The Tenth Development Plan (2014-2018) Energy Efficiency Improvement Program Action Plan. The latter directed to old buildings that need upgrading (TTDP, 2014). Also, the Strategy Paper expands on building rehabilitation for reducing emissions and energy consumption. Another critical element in the strategic plan relates to the National Energy Efficiency Action Plan (NEEAP) which priorities EU efficiency target for 2020 as well as the 2009/125 / EC and 2010/30 / EU Directives (NEEAP, 2018).

Executive decisions are paving the way for a sustained reduction in the use of energy. This enables establishing specific targets with a focus on energy consumption, CO_2 emissions and the enhancement of renewable energy sources. All this under the umbrella of the EU zero energy target (BEP, 2019; NEEAP, 2018; NREAP, 2014). The vehicles to achieve these targets include the EIC of buildings that is mandatory for selling, buying and renting of the buildings and requires renewal every ten years (RTOG, 2010b). The certificate label should be minimum C for new buildings. The legislation builds on the strategic objective of transforming at least one-quarter of the building stock into a sustainable building by 2023 to expand sustainable, environmentally friendly buildings that use renewable energy resources. At the same time, it aims at reducing the energy intensity of the country by 20% until 2023. Public housing and urban regeneration projects provide significant opportunities to achieve this goal. In this process, coordination between national and international organisations is important, and this coordination is planning by NCCAP to provide for renewable energy, energy efficiency by 2023. NCCAP has also set strategic targets for increasing energy efficiency by reducing losses in electricity distribution and transmission by 15% at 2030 and renewable energy usage by increasing electricity production capacity of solar power and wind power to 10 GW and 16 GW by 2030, respectively. An additional objective is to reduce total greenhouse gas emissions by 21% below its business-as-usual level between 2012 and 2030.

Similarly, the National Renewable Energy Action Plan (NREAP) aims at lowering emissions and improve energy efficiency by increasing renewable energy capacity to 5GW solar power, 20 GW wind energy, 34 GW hydropower, 1 GW geothermal and 1 GW biomass. In this context, the installation of solar water heaters across 50% of existing households would enable nearly 9TWh annual save from coal, oil and gas and 2TWh annual save from electricity and 5 million tons CO_2. Such savings account approximately 1% decrease in the total CO_2 emissions in Turkey (Toklu et al., 2010). The NREAP action plan does not detail pathways to promote renewable energy use in buildings. However, NEEAP does include actions to promote on-site production and renewable energy use in buildings. NEEAP also seeks to develop guidelines for each of the different materials, equipment and technologies used in new or refurbished buildings, including energy performance criteria and efficiency analysis until 2019.

The common target for the policy items is training which is for managers to increase the current knowledge level on EPBR and energy efficiency measures. These training are essential for new and required targets to progress. The energy management program and building energy certification system are at the core of the agenda managed by the Ministry of Energy and Natural Resources. Currently, the state sets the strategic targets for increasing energy efficiency and is looking into ways to ensure their effective implementation and promotion all over the country (NEEAP, 2018).

Discussion

The targets that highlight the energy efficiency of buildings for sustainability have drawn attention, as seen in Table 1. In this context, some countries such as EU, Denmark, and Canada have highlighted the target of renovating buildings in order to increase energy performance, while other countries have mostly aimed at saving energy in new buildings in Table 1. In specific, Turkey's policies on energy efficiency are in many forms driven by world developments. Even so, the country has defined action plans tailored to their own needs. These actions mostly customised for the public, residential or commercial buildings. Until 2023, 20% energy saving target for public buildings came to the fore. This target is followed by the renovation of the existing building stock, thermal insulated and energy-efficient 1 million buildings, and one-quarter sustainable building stock by 2023, as seen in Table 3. A projection made in 2009 suggested potential savings across the building sector that amount 7.1 Mtoe (EC, 2015) that, according to NEEAP (2018), has been reached within the period 2000-2015. In addition to that, between 2012 and 2014, a %3 reduction in energy consumption was observed for the building sector (MENR, 2016b). From this situation, strict regulations can be effective. For example, the thermal insulation plan has started to implement in new buildings as a mandatory document for every construction permit in 2000 and then Turkish Heat Requirement Identification Certificate in 2008. Finally, EIC certificate released in 2010, which has strict regulations on reducing heat losses in the envelope (RTOG, 2008a, 2008b, 2008c).

European countries have set escalated targets to decrease greenhouse gas emissions. These should accomplish results by 2020, 2030, 2040 and 2050 (EPBD, 2018). EU's predominant aim set to 2050, which contrasts with milestones established by South Korea, Denmark, Japan, and Turkey, where emission targets prioritise the projection 2030. Turkey now works against the ambitious milestone of reducing total greenhouse gas emissions by 21% below its business-as-usual level between 2012 and 2030. Statistical information suggests a 10% decrease between 2012 and 2014, as seen in figure 2. In order to continue this decline, stringent administrative sanctions started to implement from 2017, regarding threshold values linked to emissions. In addition, some of the emission reduction targets also privatized for public buildings.

Turkey's strategic plan to reducing greenhouse gas emissions relies on the adoption of best practices ranging from clean energy generation to policy and legislation. Although natural gas use has grown in the country, fuel-related emissions are still increasing (TSI, 2019). The country aims at reducing the use of energy in 8-10% annually with the potential to raise savings to 20% by 2020 (Toklu et al., 2010). NCCAP (2011) aims to meet at least 20% of the annual energy needs of new buildings with renewable energy sources by starting from 2017. According to NEEAP (2018), these objectives could realise if site energy production develops. Turkey has set specific targets to promote the use of renewable energy in buildings via EESP, NCCAP and NEEAP while infrastructure development derives from the EPBR suite of guidance. There is also evidence for exploring alternative clean energy sources. For example, between 2002 and 2015, the use of geothermal sources for heating in buildings and thermal facilities increased by 281% (MENR, 2016b). Moreover, to date, 260 000 households use geothermal heating, whereas applications of a similar nature could upgrade the heating of 500 000 houses and the cooling of 50 000 additional ones

(TTDP, 2014). Building on this, according to (Yüksel & Arman, 2014), Turkey has the potential to increase its geothermal energy capacity to 1.2 million houses by 2020. Particular attention is to be paid to hydroelectric re-development, which so far exploits as much as 35% of its potential (Yüksel & Arman, 2014). Turkey has yet to overcome financial constraints to progress its potential (Toklu et al., 2010).

In view of the ambitious energy optimisation targets outlined above, policy stringency levels are to increase in the short-medium term. EU nations, the UK, US and Japan envisage making regulations compulsory after 2020 to achieve nearly zero targets for buildings. South Korea adopted the zero target by 2025 through more strict regulations (IEA, 2017a). China would also have strict policies in place or in preparation, to fulfil their commitments. Turkey has not yet established clear milestones for raising stringency levels for zero energy buildings and is more focused on the identification and dissemination of requirements (NCCAP, 2011). However, public and private buildings built after 2020 planned to be nearly zero-energy (NEEAP, 2018). In NCCAP, assessment of performances of real and model buildings intends to fine-tune the EPBR with BEP-TR tool and algorithm to accomplish energy efficiency milestones set by 2018. To support that objective, the Green Building certification came into force in 2017- with the private sector now heading on further green building activities (Aktas & Ozorhon, 2015). Furthermore, as per the Tenth Development Plan (2014), licensing procedures of the buildings having heat insulation are exempt from taxes and charges by the local administrations. This is an ongoing plan, which has produced some positive outcomes. For example, according to statistical data, 329 063 buildings have obtained the EIC (BEP, 2019). It is predicted that one fourth of the existing building stock, and 7.56 million new dwellings will have been categorised with C label by 2023 (Gurlesel, 2012).

Significant improvements in the energy efficiency of household appliances have occurred. With the enactment of the Energy Labels for Households Appliances Law, the energy consumption reduced by up to 60% over ten years (Keskin, 2010). In addition to that, automatic systems and central control systems, regulatory frameworks promote expanding such technology to optimise heating, cooling, air-conditioning and lighting systems of buildings.

Energy manager training is getting attention and noting that the number of certified energy managers of buildings reached 2205 entries in 2018. Also, education seminars have run for employees, households and students, for raising public awareness and literacy on energy efficiency and renewable energy sources and usage. The sustainable renovation of the buildings, driven by the public sector, adds up towards generalising green and sustainable buildings (Aktas & Ozorhon, 2015).

Within the remit of the Energy Efficiency Etude and Energy Identity Certificate for Public Buildings, a partial amount of 352 properties have upgraded until 2018, out of which 55% relate to estates facilities. More in-depth studies show a reduction of 1.5% per m^2 of energy consumption across the referred subset while the monitoring of energy efficiency of additional 1430 buildings continues (MENR, 2018). Turkey's implementation of policies and strategies seems synchronised with the move by stakeholders to adopt best practices. For example, in 2010, Turkey launched its Market Transformation of Energy Efficient Appliances campaign, which supports directives set by EU eco-design and energy labelling systems. According to (MENR, 2016b) this has accelerated labelling while popularised training during 2015.

High-energy building performance is becoming a common target for countries worldwide. To engage in that movement, Turkey has been developing policy and legislation to cover both passive and active design strategies such as the implementation of sustainable insulation systems and automated management of heating and cooling. This trend could intensify if low- carbon emission materials and higher efficiency technologies were in the market as well as considered in the strategy and policy papers. Through the implementation of upgraded regulations, one could expect seen around 7.5 million isolated houses by 2023, which would derive in a fall of energy consumption to pass from 44 kWh/m2 recorded in 2012, to 20.5 kWh/m2 by 2023 (ATCMP, 2014). In such a scenario, nearly half of the 25.56 million existing domiciles would be energy efficient by 2023 (Gurlesel, 2012). The renovation of the building is also a core objective across EU nations. Investors and developers now engage in financial strategies involving long-term payback periods for the transformation of existing building stocks into nearly zero existing buildings beyond 2020 (original milestone). Recently, some EU countries located in seismic areas, and Japan, integrated safety and sustainability of their infrastructure in building codes. Turkey is to follow such action, given its susceptibility to tectonic motions that often results in large numbers of damaged buildings.

Worldwide eco-trends are uniformising. Constraints to achieving this include obvious differences that distinguish culture, education, economy and engineering practice. According to Iwaro & Mwasha and Lucon & Urge-Vorsatz (2010; 2014), the greatest obstacles that are preventing developing countries from engaging with international movements include low awareness levels, limited access to technology and qualified labour. Turkey is not free from such constraints, although its developed strategies are driving a change (Keskin, 2010). To mitigate financial issues, Turkey introduced two programmes: the Sustainable Energy Financing Program (TSEFP) and the Residential Energy Efficiency Financing Program (REEFPT), in addition to one credit scheme to protect energy and labour (Şekerbank EKOkredi). According to

(ATCMP, 2014), the latter has already prevented more than 2.5 million tons of carbon emissions.

Turkey, is, therefore, driving change through the merging of policy and legislation into concise strategies to progressing their sustainability goals.

Conclusions

The current policies and strategies in Turkey have been investigated with respect to the sustainability of buildings. Factors playing a role in the country's development include stringency and scope of the policies & strategies. These, together with the adoption of examples of good practice across the world, have contributed to shaping the national action plan for the efficient utilisation of sustainability. It turns out that leading countries in this subject across continents demonstrate a high level of engagement with policymaking and enforcing. These factors can translate into strong regulations, financial stimuli, and commitment, supported by law, strategy and transparency. With increasing urbanisation and population, it is inevitable that the number of new buildings will increase. For this reason, it is critical to ensure that new designs reflect sustainability attributes. Turkey is taking concrete actions to raise their performance levels and is starting to raise the level of stringency via certification and legislation, set to be mandatory after 2020.

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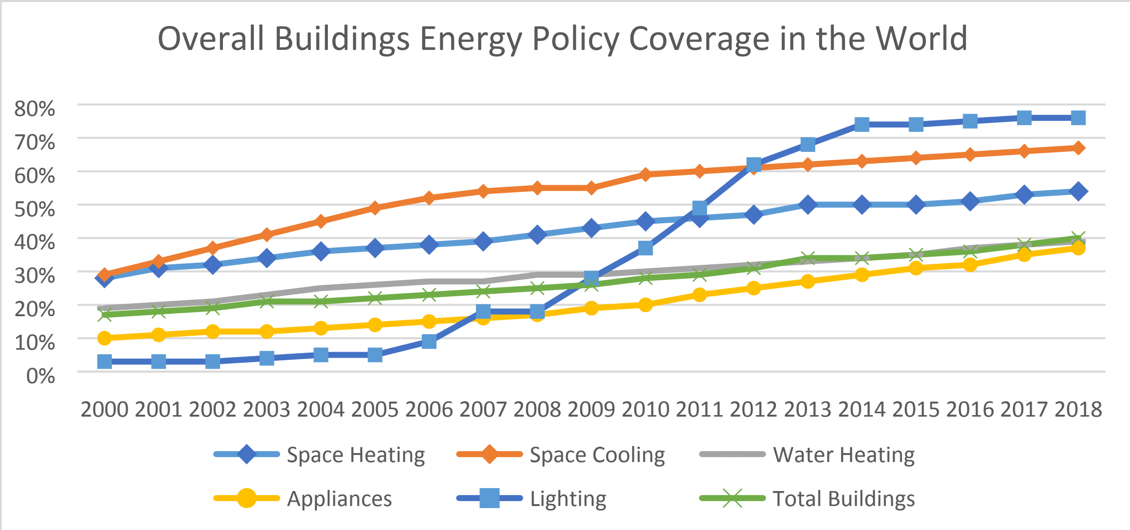

Figure 1. Global energy policy coverage on buildings. Sources: (IEA, 2019a).

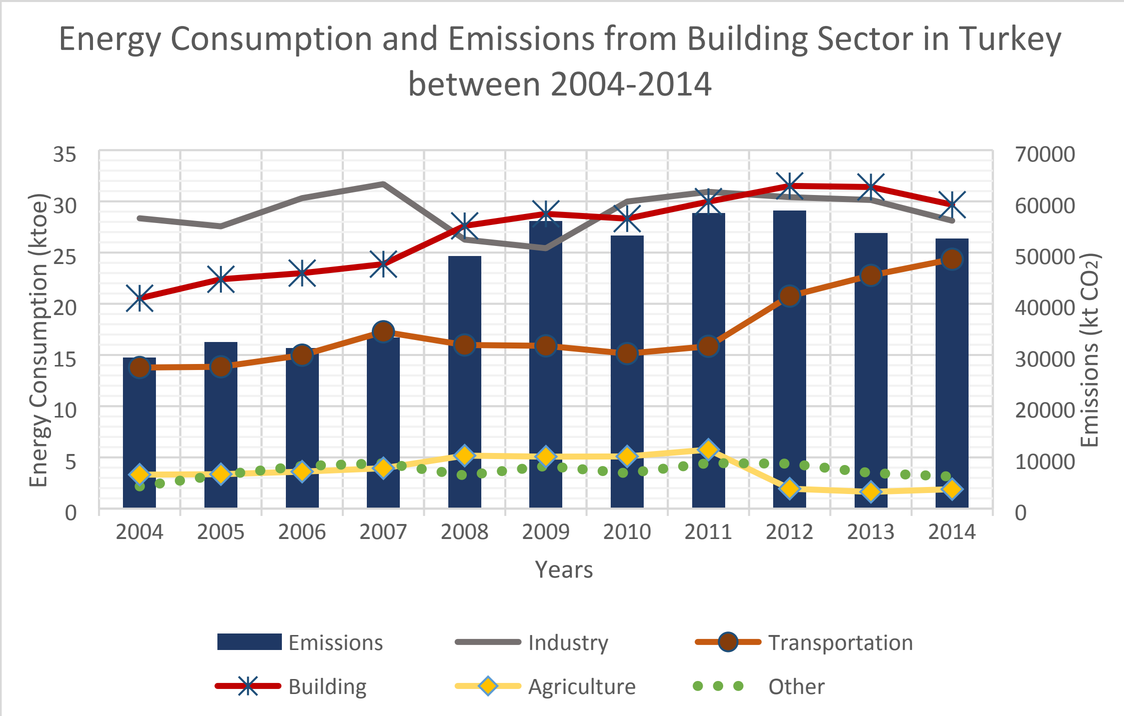

Figure 2. Sectoral distribution of energy consumption and building sector emissions in Turkey. Sources: (MENR, 2016b; TSI, 2019b).

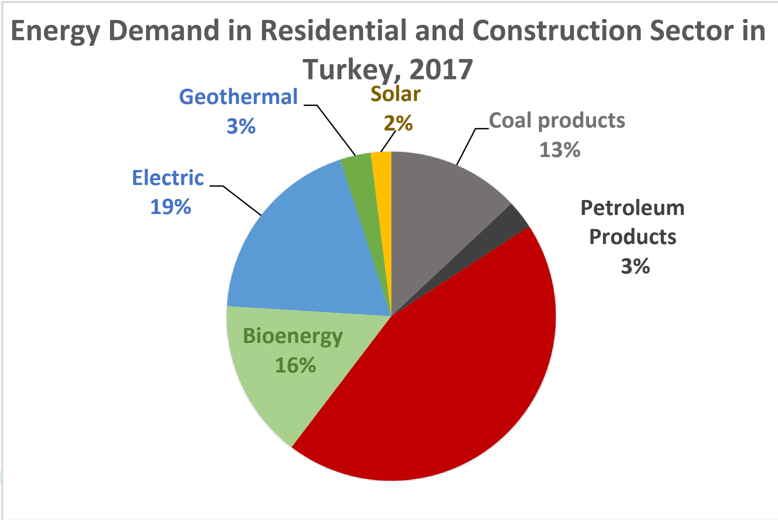

Figure 3. Energy demand breakdown in residential and construction sector of Turkey in 2017. Sources: (MENR, 2017).

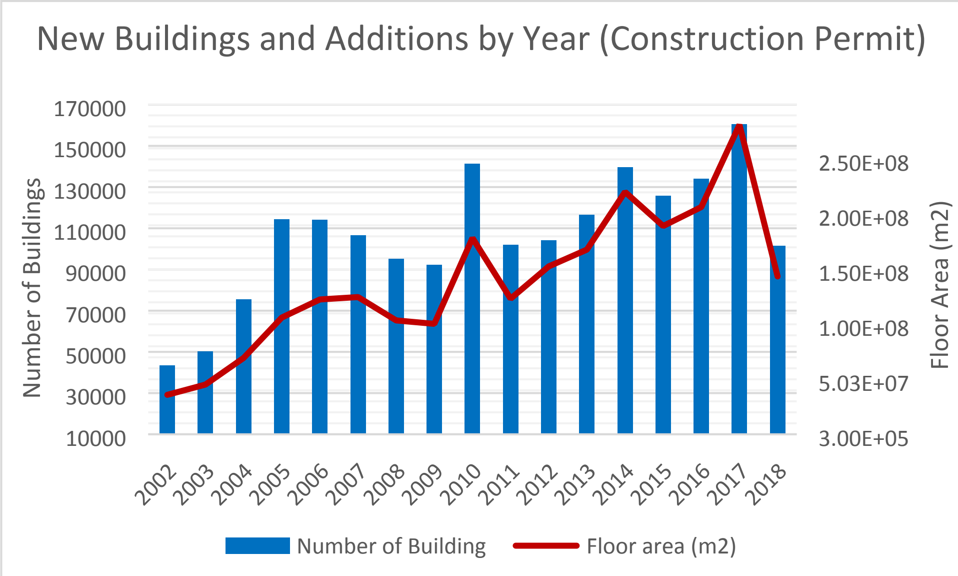

Figure 4. Annual number and floor area of new buildings and additions according to construction permits in Turkey. Sources: (TSI, 2019a).

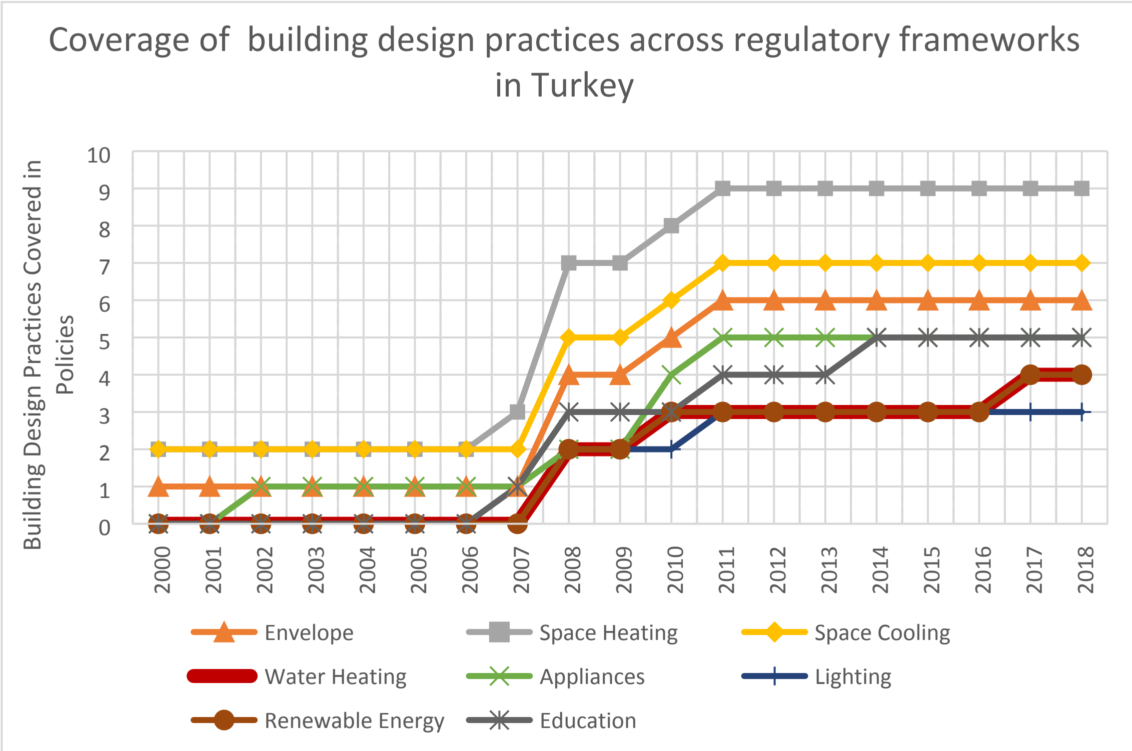

Figure 5. Coverage of Building Design Practices in Policies Related with Sustainability in Buildings of Turkey Between 2000 and 2018.

Table 1. Specific sustainability target samples for buildings from the world.

Country/ Union	Targets			
	Energy Saving	Emissions Reduction	Renewable Energy Sources	Nearly Zero Energy Target
EU	*Mandatory of annual renovation on minimum energy performance for at least 3% of the central government buildings' total floor area (EPBD, 2018). *Obligation energy efficiency in the renovation of existing buildings and energy investments of public authorities for building stock by establishing long-term strategies (EED, 2018). *20% energy efficiency improvement by 2020 in the building and public transport sector (EC, 2019b).	*Implementation a roadmap for low and zero carbon building stock by reducing %80-95 GHG emissions compared to 1990 in the EU by 2050, prior to this 2030 and 2040 are also within the targets (EPBD, 2018). *Reducing emissions by improving the energy performance of buildings, encouraging for energy certification and environmentally friendly energy products, new technologies (EC, 2019a).	*Promoting installation of renewable energy by %30 energy generation; obligation period from 2014 to 2021 (EED, 2018). * Renewable energy is necessary for low energy in nearly zero buildings. Therefore, considering renewable energy sources is mandatory (EPBD, 2018).	* All public buildings built after 2018 and all buildings built after 2020 need to be nearly zero (EPBD, 2018). *Transformation of building stock into nearly zero-energy buildings with long-term plans in investment, cost and energy efficiency (EPBD, 2018).
Denmark	*Approximately 8% reduction (to be around 175 PJ) of total energy consumption of households by 2030 below 2015 level. 75% reduction of energy consumption in buildings by 2020 below 2006 level (DEA, 2017). *Renovation of all existing buildings by 2050 (EA, 2008).		* Increasing local use of renewable energy (EA, 2008).	All new buildings built after 2015 will be zero energy (%50 reduced energy consumption compared with 2006) and mandatory of fuel-efficient buildings by 2050 (EA, 2008).
US	*%30 decrease in average thermal load for existing buildings, every new building must be 30% more energy-efficient than IECC and ASHRAE codes' requirements after 2007 and it must be 70% by 2020 (Doris, Cochran, & Vorum, 2009). *30% energy saving for non-residential buildings in California (IEA, 2018).	*70% reduction in carbon emissions with current policies via reduction of energy from new buildings by 2020 (Knowles, 2008) *Promoting intelligent efficiency technologies (Leung, 2018).	* Minimum 25% reduction of the total amount of building electric energy and thermal energy by renewable electric energy and alternatives by the fiscal year 2025 (FR, 2015). * After 2018, solar PV systems are necessary for new homes according to the California 2019 Building Ene rgy Efficiency Standards (IEA, 2018).	*Net-zero energy for all new residential construction by 2020 and for all new commercial construction by 2030.Net zero for all commercial buildings by 2050 (Crawley, Pless, & Torcellini, 2009). * Ensuring net-zero all new Federal buildings over 5000 gross square feet area by 2020 and intended net-zero existing buildings over 5000 gross square feet area by 2025 (FR, 2015).
Canada	*%10 energy saving compared to 2011, promoting energy retrofitting in existing buildings and increasing the energy performance of appliances (IEA, 2018).	*Funding investments of projects to reduce greenhouse gas emissions (IEA, 2018).		*Introduced Zero Carbon Standards by Canada Green Council, with 16 sample pilot projects (IEA, 2017b). *Achieving net-zero energy ready buildings by 2030 (IEA, 2018).
Japan	*Promoting energy efficiency measures (METI, 2017).	*Reducing carbon emissions with the enforcement of the "Low Carbon City Act" (MLIT, 2019).		* Zero energy level of new public buildings by 2020, and new public and private buildings by 2030 (METI, 2015a). * Zero emission level in standard new built houses by 2020 and average zero-emission level in newly built

				houses by 2030 (METI, 2015b).
South Korea	*38 Mtoe overall energy saving by 2030 and 32% (12 Mtoe) in the residential and commercial sector.	*37% reduction (18.1% in the building sector) of greenhouse gas emissions by 2030 (Jeong, Hong, & Kim, 2018). * Regarding the reduction of emissions from buildings, 50%, 25% and 25% for existing buildings, new buildings and improvement of occupant behaviour, respectively (Koo et al., 2014).	*Expanding markets for renewable and new energy by promoting these energies and providing discounts on installation costs (KEA, 2015a).	* Zero energy constructed of all buildings by 2025 (IEA, 2017a). * One million new green home by 2020 and in total 2 million energy-efficient/environmentally friendly house by 2020 (KEA, 2015b).
China	*50% energy decrease in new buildings (Nejat et al. 2015). Increasing the application of energy efficiency higher standards and 75% energy saving compared to 1980s building standards (IEA, 2015).			At least 50% of new buildings will be green in 2020 (IEA, 2015).

Table 2. Policies on the sustainability of buildings in Turkey.

Policy and Legislation Item	Outline	Building Design Practices Covered							
		Envelope	**Space Heating**	**Space Cooling**	**Water Heating**	**Appliances**	**Lighting**	**Renewable Energy**	**Education**
The Thermal Insulation Regulations of the Buildings (No. 24043/2000 and renewed No.27019/ 2008)	Regulates the principles of application for energy saving and reducing the heat losses in buildings (RTOG, 2000b).	•	•	•					
Regulation on Performance of Heat Generators Used for Hot Water Production and Space Heating in New or Existing Non-Industrial Buildings, and Implementing of Internal Hot Water Distribution and Thermal Insulation in Non-Industrial Buildings (No.24260/ 2000)	Defines the principles for the economic use of energy, energy-saving to protect the environment and economic heat insulation for heating systems when installing new heating systems (RTOG, 2000a).		•		•				
Energy Labels for Households Appliances Law (No. 4703/2002, No. 26376/2006, No. 27478/2010)	Defines the energy labelling of the appliances regarding energy consumption and eco-design requirements (RTOG, 2002).					•			
Energy Efficiency Law (No. 5627/2007)	Conducts the implementation of measures to improve energy efficiency for all sectors, reducing the energy cost on the economy, protecting the environment via efficiency in energy resources and regulates the related policy (RTOG, 2007).		•						•
Renewed The Thermal Insulation Regulations of the Buildings (No.27019/2008)	Regulates the procedures and principles regarding the reduction of heat losses in buildings, energy-saving and implementation (RTOG, 2008a).	•	•	•					
Regulation on Improving Efficiency in the Use of Resources and Energy (No.27035/2008)	Regulates the procedures and principles for increasing the efficiency of energy use (RTOG, 2008c)	•	•	•		•	•	•	•
Regulation on the Distribution of Heating and Sanitary Hot Water Expenses in Central Heating	Determines the principles regarding the distribution of heating and sanitary hot water expenses in the existing and new buildings with central or district heating and sanitary hot water systems (RTOG, 2008d).		•		•				

and Sanitary Hot Water (No.26847/ 2008)									
Energy Performance of Buildings Regulation (EPBR) (No. 27075/2008)	Determines minimum energy performance requirements for buildings by considering outdoor climate conditions, indoor requirements, local conditions and cost-effectiveness. Regulates the application of renewable energy systems, limitation of greenhouse gas emissions and control of heating and cooling systems (RTOG, 2008b).	•	•	•	•		•	•	•
(Revised) Energy Performance of Buildings Regulation (EPBR) (No. 27359/2010)		•	•	•	•	•		•	
Implementing Regulation on Environmentally Friendly Design of Energy-Related Products (No. 27722/2010)	Determines the framework of the conditions that must be complied within the design of energy-related products by increasing energy efficiency, environmental protection level (RTOG, 2010c).					•			
(Renewed) Regulation on Improving Efficiency in the Use of Resources and Energy (No.28097/2011)	Regulates the principles and procedures regarding the efficient use of energy, prevention of energy waste and increasing the efficiency in the use of energy resources and energy for the protection of the environment, and covers energy efficiency training and certification activities (RTOG, 2011).	•	•	•		•	•		•
Regulation on Certification of Sustainable Green Buildings and Sustainable Settlements (No. 29199/ 2014)	Regulates the principles and procedures for establishing assessment and certification systems for sustainable green buildings and sustainable settlements (RTOG, 2014).								•
(Revised) Energy Performance of Buildings Regulation (EPBR) (No.30051/2017)					•			•	
Green Certificate Regulation for Buildings and Settlements (No.30279/2017)	Regulates the procedures and principles related to the establishment of assessment and certification systems, assessment and certification process in order to mitigate the negative effects of buildings and settlements on the environment by using natural resources and energy efficiently (RTOG, 2017b).								

Table 3. Turkey's specific sustainable buildings objectives.

Strategy	Targets: Energy Saving	Targets: Emissions Reduction	Targets: Renewable Energy Sources	Targets: Nearly Zero Energy Target
National Climate Change Action Plan 2011-2023 (NCCAP) (NCCAP, 2011)	* Heat insulated and energy-efficient at least 1 million residential building, and public and commercial buildings with more than 10,000 m^2 by 2023 * Increasing energy saving in public buildings by 20% until 2023 * Promoting in situ energy generation in housing estates	* Emissions reduction in new settlements by at least 10% compared to existing settlements by 2023	* Increase the use of renewable energies and local energy *Necessary renewable energy systems with appropriate pre-investment cost, with 10 years pay-back period new buildings with less than 20,000 m^2 floor area and 15 years for new buildings with 20,000 m^2 or more * Necessary solar power systems for central space heating and hot water for non-residential buildings with more than 1,000 m^2 * Encouraging the usage of renewable energy via meeting at least 20% of the annual energy demand of new buildings as from 2017	* Increase zero energy, passive energy and green building design * Encouraging usage of low-zero carbon technologies and clean coal technologies * Upgrading EIC certificate classification levels and providing coordination between revised EPBR and TS 825 by 2023
Energy Efficiency Strategy Paper 2012-2023 (EESP) (EESP, 2012)	*10% reduction in energy consumption of public buildings by 20% by 2023 *At least 20% reduction below 2011 values in the amount of energy intensity consumed per Gross Domestic Product by 2023 * Meeting with the current standards for heat insulation and energy-efficient heating system in commercial and service buildings with a useful area over 10000m^2 *Increasing Energy Efficient products	* Administrative sanction for exceeding minimum CO_2 value from 2017 onwards * Promotion of sustainable and environmentally friendly buildings	* Promotion of renewable energy resources in mass housing projects	

	* To be sustainable of at least one-quarter of the building stock in 2010 until 2023 *20% reduction below 2013 values in energy consumption for buildings related to the ministry			
National Renewable Energy Action Plan 2013-2023 (NREAP) (NREAP, 2014)			*Promoting of renewable energy use in buildings	
Strategic Plan 2015-2019 (SP, 2015)	*20% increase in energy efficiency in the buildings of Ministry of Energy and Natural Resources compared to 2013 energy consumption levels * Implication of smart devices for monitoring energy consumptions in pilot buildings	* Rehabilitation of ministry buildings to decrease CO_2 emissions		* Obligation of Energy Identification Certificate at C level in new buy and rented ministry buildings
National Energy Efficiency Action Plan 2017-2023 (NEEAP) (NEEAP, 2018)	*Establishing a database including energy consumption data of buildings until 2020 * Rehabilitation on existing buildings: replacement of building insulation, heaters, HVAC devices, lighting, hot water, daylighting systems, home automation * Promoting central and district heating systems in housing estates and large dwelling units with starting application after 2020 and promoting it in existing housing estates until 2023 * Financial support for energy efficiency measures in buildings * Establishing pilot projects in selected cities to implement the energy efficiency projects * Increasing implementation of energy efficiency	* Administrative sanctions for buildings causing higher CO_2 emissions than standards	* Promoting integration of renewable energy and cogeneration technologies to buildings * Promoting district heating system using geothermal potential and waste heat from industrial and power generation facilities until 2023 * Facilitating the use of PVC solar panels	* Increasing the number of Energy Identification Certificate in existing buildings and sanctions on inefficient buildings will be evaluated after 2021 * Promoting of Green Building Certification Implementation * Planning target for an obligation of nearly zero energy building for new public and private buildings after 2020

investments in public buildings after 2019