Energy Efficiency (2024) 17:52
https://doi.org/10.1007/s12053-024-10217-w

REVIEW ARTICLE

Characteristics of the built environment in the Eastern Mediterranean and Middle East and related energy and climate policies

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Received: 27 April 2023 / Accepted: 12 March 2024

Abstract The Eastern Mediterranean and Middle East (EMME) region hosts some of the world's most influential and troubled cities. It is also a hotspot of climate change and socio-economic and political turbulence, which inflate the already flammable conditions and reinforce existing local vulnerabilities. Some of the most arduous challenges of cities relate to the built environment – although vital for human well-being, buildings rarely offer both sufficient and affordable shelter to their inhabitants. With energy performance regulations coming into effect during the past three decades, a considerable proportion of the worldwide building stock had already been constructed and is now ageing and inefficient. Harmonising the energy performance of buildings at a sufficient level requires common objectives and priorities, and the EMME region consists of nations with different governance and regulations. Scarce literature exists on the existing operational frameworks, and this study aims to offer an overview of the built environment policy scene in the EMME region, identifying gaps, good practices and prospects. The study draws from scholarly literature, national and international regulations and other document sources, as well as local

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Published online: 04 June 2024

experts. This work finds that although most EMME countries participate in and embrace international agreements, they act individually and not collectively, confirming our hypothesis that the policy agenda reflects the diverse characteristics of the region. By recognising standing failings and strengths, moving forward becomes a possibility through the adoption of integrated governance, common policy agendas and financing mechanisms to create sustainable urban centres inhabited by resilient and equitable communities.

Keywords Eastern Mediterranean · Middle East · Climate change · Built environment · Policy · Building standards

Introduction

Places and people are transformed by the circumstances they are found in, the interplays between them and the force of unexpected externalities. The Eastern Mediterranean and Middle East (EMME) region is a conglomeration of distinct yet similar countries. There are countless differences in the evolution of nations in the EMME region, as well as in socio-economic conditions and geographic settings. Still, all EMME countries face similar challenges induced by climate change and its impacts (Lelieveld et al., 2012). The current state of the built environment and the struggle to create sustainable cities and societies are among the most compelling challenges affecting them. Millions of people inhabit these cities, and while some of them are adequately sheltered and can live a comfortably modern lifestyle, others live in informal settlements and struggle with access to a basic level of services, including healthcare, energy, sanitary water and housing (Kyprianou et al., 2022).

Politically and geographically, the EMME countries are diverse and multi-ethnic. In the definition adopted here, the region includes countries from Europe (Cyprus and Greece), North Africa (Egypt), the Middle East (Israel, Jordan, Lebanon, Palestine, the Syrian Arab Republic and Türkiye), the Arabian Peninsula (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates) and Western Asia (Iran and Iraq). The region's climate is mostly classified as arid to semi-arid, comprising a variety of features, landscapes and vegetation covers. This includes extended mountain ranges and desert areas, as well as agriculturally utilised lowlands such as the Fertile Crescent between the Euphrates and Tigris rivers, known as Mesopotamia. Major rivers and their tributaries and floodplains also cross the EMME region, allowing for productive agriculture. The region's coastlines extend along the Mediterranean Sea, the Persian Gulf and the Red Sea. Urban areas include the megacities of Cairo and Istanbul, with their larger metropolitan areas being populated by more than 20 and 15 million inhabitants, respectively, and the city of Tehran, with 9 million. The region's human geography is characterised by a significant split between urban and rural lifestyles and living conditions. Prosperity, both at the individual and national level and economic performance, differs starkly between those countries with significant hydrocarbon resources and those without (Baysoy & Altug, 2021). Other challenges include exponential population growth, intense urbanisation, the uneven allocation of rudimental resources such as water and high military spending amid chronic regional conflicts. Meanwhile, efforts at greater integration into the global economy often aggravate long-standing inequalities and create further downstream challenges.

In terms of socio-economic conditions, after the long struggle endured in most countries of the region to gain independence from their colonial European rulers, the nationalist regimes that came to power tended to maintain significant control over their economies. In the early 20th century, the discovery of vast oil deposits in the Middle East coincided with increasing oil dependence in the West, creating ever-shifting global political dynamics (Freeman, 2021; Khatib, 2014; Khodjaeva et al., 2021). New opportunities arose in the EMME region, and since then, the build-up of the oil industry has created enormous opportunities for development in hydrocarbon-rich

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countries, particularly in Bahrain, Iran, Iraq, Kuwait, Qatar, Saudi Arabia and the United Arab Emirates.

Socio-economic conditions affect the buildings and other urban structures of the EMME region, and vice versa; advancement embraces new materials and habits, and the state of the built environment influences livelihoods. The EMME region is one of the most vulnerable to climate change and already faces numerous environmental stresses (Zittis et al., 2022). In the future, available water and arable land resources will diminish, and air and soil pollution, degradation of ecosystems and loss of biodiversity will escalate (Meir et al., 2012). The region anticipates further downstream consequences, such as food and potable water scarcity, ultimately leading to social unrest and local conflicts, as has already been documented (Aw-Hassan et al., 2014; De Châtel, 2014). In addition, the expected rapid increase in population and urban growth rates will amplify these environmental stresses (Hungate & Koch, 2015). Related challenges include the proliferation of urban sprawl and the growth of illegal dwellings ('slums'), increasing population and building density and the ever-increasing demand for energy and water among city inhabitants. Moreover, a growing transport sector (including private cars, public transport and commercial vehicles) brings forward further consequences for urban infrastructure and public health [see, e.g., (Lange, 2019).

Another major challenge lies in the stark differences in income, personal wealth and lifestyles between rural and urban populations in most countries of the region. That is exacerbated in countries that rely heavily on foreign labour. Disparities can also be observed at the national level in terms of geographic and economic characteristics, as observed in Table 1. For instance, in the region's richest country *per capita*, Qatar, the 2020 gross domestic product (GDP) per person was 97 times higher than in the poorest country, Syria. At the same time, certain countries are experiencing rapid and intense population growth that is related to high levels of economic

Table 1 Geographical, economic and built environment characteristics of countries in the EMME region, modified from (Attia et al., 2012; Attia & Wanas, 2012; BSO, 2020; CAPMAS, 2020; Dabbeek & Silva, 2020; Gunes, 2015; Landolfo et al., 2022; MECIT, 2017; PADCO, 2006; WorldBank, 2023a; Worldbank, World Bank Open Data, 2021; Worldometer, 2016)

Country	Total population change 1960–2022 (%)	Oil reserves (million barrels) 2016	Urban population (%) 2022	GDP per capita 2020 (USD/person)	CO2-eq emissions (metric tons per capita) 2020
Bahrain	816%	125	90%	23,433	21.98
Cyprus	114%	N/A	67%	28,036	5.47
Egypt	311%	4400	43%	3572	1.96
Greece	27%	10	80%	17,659	4.77
Iran	314%	157,530	77%	2746	7.06
Iraq	528%	143,069	71%	4251	3.84
Israel	352%	14	93%	44,847	6.35
Jordan	1231%	1	92%	3988	1.92
Kuwait	1298%	101,500	100%	24,298	21.17
Lebanon	205%	N/A	89%	5600	3.79
Oman	753%	5306	88%	16,7082	15.64
Palestine	155%	N/A	77%	3234	N/A
Qatar	7307%	25,244	99%	52,316	31.73
Saudi Arabia	774%	266,578	85%	20,398	14.27
Syria	380%	2500	57%	537	1.21
Türkiye	210%	312	77%	8561	4.84
United Arab Emirates	6976%	97,800	88%	37,629	20.25
World average	262%	Not applicable	61%	10,896	4.29

If information is not available, it is marked as 'N/A' activity and urbanisation. For instance, the United Arab Emirates (UAE) has increased by almost 7000% since 1960, with 85% of the population living in cities; as a matter of comparison, the global population of the whole region has increased by less than 300% with an urbanisation rate of 61% (see Table 1).

Some countries experience very little fluctuations in the annual growth rates, but others sustain great ones; the trends in annual population change rate per country are observed in Fig. 1. While the annual urban growth rate in Cyprus, Egypt, Greece and Israel never surpassed 2% (or decreased), the urban population in Qatar grew by 22% in just one year (2006–2007) and shrank by 3% later on (2020–2021). Moreover, there are countries with ad infinitum growing urban populations, but there are no countries with perpetually shrinking ones – even in nations going through violent conflicts, populations may briefly show signs of decrease and then return to increasing trends (e.g. Syria's population diminished between 2012 and 2015 but started growing again from 2017 onwards). Two countries of the Gulf Cooperation Council (GCC), Qatar and UAE, experienced the most impressive population surges, starting from 2004 up to 2007. During the 20th century, urbanisation began due to the exploitation of oil reserves and continues in the 21st century through national development strategies, but the sudden influx of populations can be attributed to specific milestones. For instance, Doha hosted a mega-event in 2006 (the Asian Games), drawing not only visitors but also the workforce required to build infrastructure, and designated 'investment zones' were created in Abu Dhabi in 2005, generating critical opportunities for foreign investments that shifted the real estate market (Azzali, 2016; Samarrai, 2016). Likewise, the steep drop in the urban population of Syria between 2011 and 2014 can be attributed to the events surrounding the civil war (Deng et al., 2021).

About CO_2 emissions *per capita*, the highest polluting countries are associated with high GDP *per capita*. Most of the countries of the EMME region are highly urbanised (higher than 70%), and this exposes them to a multitude of climate change challenges and higher levels of polluting activities. Among the oil-rich countries, most enjoy affluent economies (Kuwait, Qatar, Saudi Arabia and UAE), while others (Iran, Iraq), affected by regional conflicts, have GDP *per capita* lower than the world average.

While a review of the history of the region's architecture and buildings exceeds the scope of this work, we briefly overview the main characteristics of the

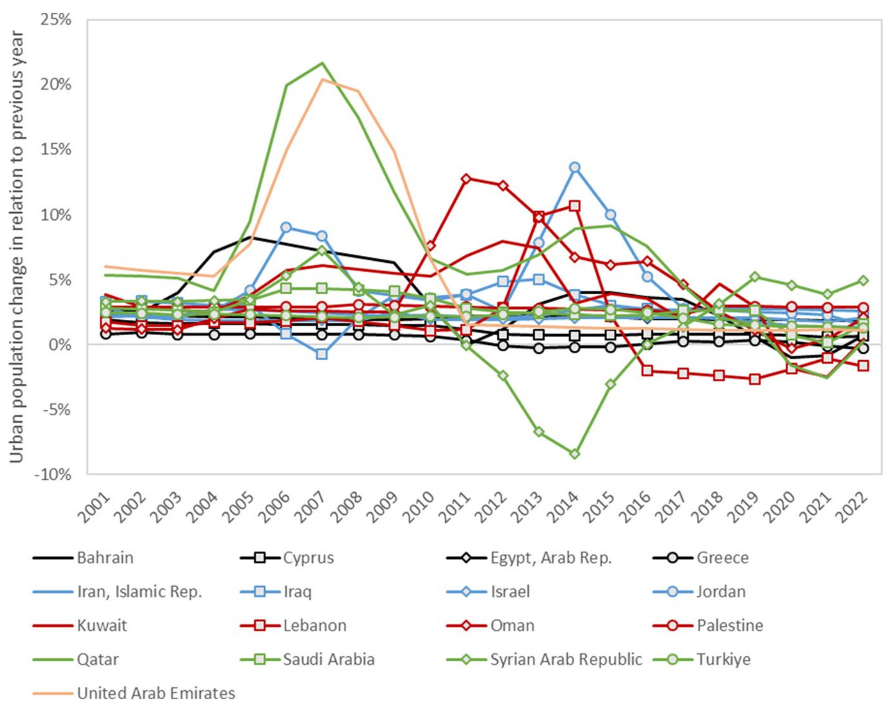

Fig. 1 Time series showing variation in urban populations for the years 2001–2022 (source: (Worldbank, World Bank Open Data, 2021))

building sector. Table 2 presents the predominant building load-bearing materials and degree of diversification, showing that the majority of the building stock is constructed with reinforced concrete, and another big part is built with masonry techniques. The rest of the building stock includes adobe and light wood frames, whereas tall buildings are constructed using a mix of steel and glass. There are three material diversification classes: low, intermediate and high, and since reinforced concrete prevails, it is used as the primary determinant for the classification. If the reinforced category is higher than 70%, the country's diversification is deemed low; if it is between 70 and 50%, diversification is intermediate, and if it is lower than 50%, diversification is high. In the case of countries for which information is lacking or sparse, estimates were made based on alternative sources (e.g. (Facts and details, cities, towns and villages in the Arab-Muslim world, 2018) for Iran, (Hoare, 2020) for Israel and (Gunes, 2015) for Türkiye).

Reinforced concrete has become the predominant option (more than 50%) for all EMME countries except for Iran, Palestine and Syria, possibly reflecting on the lower levels of the economy in general. Low diversification mostly indicates heavy reliance on concrete, with countries such as the UAE championing modern architecture that promotes reinforced concrete, steel and glass. On the other hand, intermediate diversification is related to attempts for the preservation of vernacular architecture in booming economies where modern materials are also dominant. High diversification is encountered only on two occasions – in Greece, where masonry techniques with stone are mostly observed in rural parts of the country, and in Syria, where concrete-based construction has been extremely limited during the past decade, and a variety of alternative techniques is preferred. The choice

Table 2 Predominant building materials used in construction in EMME countries

Country	Predominant building materials						Diversification
	Reinforced concrete (%)	Masonry-stone (%)	Masonry-concrete (%)	Adobe/earthen (%)	Wood (%)	Other (%)	
Bahrain	84	10	0	5	0	1	Low
Cyprus	>80	N/A	N/A	N/A	N/A	N/A	Low
Egypt	66	11	15	8	0	0	Intermediate
Greece	58	39	0	0	0	3	Intermediate
Iran	N/A	N/A	N/A	N/A	N/A	N/A	Intermediate*
Iraq	45	30	17	8	0	0	High
Israel	N/A	N/A	N/A	N/A	N/A	N/A	Intermediate**
Jordan	58	28	10	4	0	0	Intermediate
Kuwait	69	10	10	6	0	5	Intermediate
Lebanon	51	23	18	8	0	0	Intermediate
Oman	63	19	4	5	0	9	Intermediate
Palestine	47	30	15	5	0	3	High
Qatar	85	10	0	0	0	5	Low
Saudi Arabia	68	12	8	0	0	12	Intermediate
Syria	44	26	15	10	5	0	High
Türkiye	52	N/A	N/A	0	0	1	Intermediate***
United Arab Emirates	85	10	0	0	0	5	Low

Sources: modified from (Attia et al., 2012; Attia & Wanas, 2012; BSO, 2020; CAPMAS, 2020; Dabbeek & Silva, 2020; Facts and details, cities, towns and villages in the Arab-Muslim world, 2018; Gunes, 2015; Hoare, 2020; Landolfo et al., 2022; MECIT, 2017; PADCO, 2006). If information is not available, it is marked by 'N/A'

*Information estimated from (Facts and details, cities, towns and villages in the Arab-Muslim world, 2018)

**Information estimated from (Hoare, 2020)

***Information estimated from (Gunes, 2015) of building materials, therefore, seems to march along the pace of the economy, with some countries partly retaining fragments of their cultural heritage and others completely opting for cutting-edge technologies for their urban fabric. Although new materials and construction methods aim at improving the living conditions and comfort of inhabitants, their adoption comes at a high cost. Low recycling rates in the building industry mean that construction and demolition waste continuously increases and new materials are continuously created, spending large amounts of energy and water and releasing greenhouse gases in the process (Kabirifar et al., 2020). The lesser material-intense principles of vernacular architecture can be studied to draw inspiration, all the while understanding its limitations (Beccali et al., 2018; Meir & Roaf, 2005; Oikonomou & Bougiatioti, 2011). All these issues must be seen in light of ongoing and anticipated climate change. The enhanced warming resulting from the urban heat island (UHI) effect will lead to additional challenges in the built environment [e.g. (Santamouris, 2007), especially if prioritisation is given to economic benefit and fast construction.

In line with the global community, countries in the EMME region recognise the urgent need to address regional and national climate change impacts, exhibiting a willingness to comply with international commitments stipulated by the United Nations' Paris Agreement (Horowitz, 2016). However, keeping in line with the region's diverse socio-economic conditions, diverse pathways towards the achievement of the Paris Agreement's goals are expected. All of the included countries carry a rich cultural heritage and geopolitical priorities to their unique circumstances, often following predetermined paths operating based on singularity, rather than collectivity. We hypothesise that the climate change and energy policy landscape in the EMME region reflects the diversification discussed throughout Tables 1 and 2 in terms of scales of economies, urbanisation rates, carbon footprints and preferences for building practices and materials.

Several policy meta-analyses on European regulations indicate a mature state of policy implementation and assessment on energy and climate planning (Economidou et al., 2022; Economidou, Ringel, et al., 2020), energy efficiency in buildings (Economidou, Todeschi, et al., 2020) and nearly zero energy buildings (D'Agostino et al., 2021). The same cannot be said for other EMME countries, where research outcomes focus on case studies and policies are not discussed in depth. The most recent energy policy analysis is dated in 2010 and is focused only on six countries of the Gulf Cooperation Council (Reiche, 2010). In case studies, Alqahtani and Alareeni (2020) highlight the weaknesses in sustainable building design and integration of renewables in the Kingdom of Bahrain (Alqahtani & Alareeni, 2020) and Gamaleldine and Corvacho (2022) quantify the potential environmental impacts of building energy codes, in terms of energy savings and thermal comfort enhancement (Gamaleldine & Corvacho, 2022). Evidence-based work emerges in the fields of energy efficiency and savings, decentralised renewable systems and frameworks that promote and enhance sustainability (Abubakar & Dano, 2020; AlHashmi et al., 2021; Al-Homoud & Krarti, 2021; Almushaikah & Almasri, 2021; Balabel & Alwetaishi, 2021; Elshurafa & Muhsen, 2019; Krarti, 2019; Salah et al., 2021; Souayfane et al., 2023), most of them fixing on the developed countries of the region. Supporting this finding, a study on the landscape of research and development (R&D) in the Arab region shows that the UAE and Qatar are leading in competitiveness indices (Badran, 2018). On some occasions, research findings may create more questions than the ones they address, such as in the study of Al-Saidi, who argues that the Saudi energy transition is underway, juxtaposing the petrochemical industries with the integration of renewables in their facilities in one of the biggest carbon-fuel exporting countries of the region (Al-Saidi, 2022). Investigations across the EMME appear, therefore, uneven, and a research gap emerges in the field of energy policy studies dedicated to the built environment.

This study provides an overview of the policy landscape in building performance regulation in the EMME region, and its specific objectives are to identify gaps, good practices and prospects towards reaching international sustainability goals. The research question addressed here is '*What does the built environment policy landscape look like in the Eastern Mediterranean and Middle East and how are countries addressing the threats of climate change, individually and collectively?*'

At the moment, the literature examining the diverse policies of this region is limited and main policy documents are only available in the local languages; therefore, the present work fills in a considerable gap. The structure of this article continues with a review of the international policy scene, followed by policies and regulations in the EMME region, organised in the sub-regions of North Africa, the Middle East, the Arabian Peninsula, Western Asia and members of the European Union (EU). Matrix analysis of currently implemented and pledged climate change policies is then employed to identify open gaps and future directions, ending the study with conclusions and a distillation of good practices.

Policy landscape

This section outlines major policy initiatives across international, regional and national scales, highlighting the most recent developments in governance within the building sectors for each investigated area.

International policies on climate change adaptation and mitigation

The adoption of international agreements, led by the United Nations in 2015, introduced new agendas for climate change adaptation for urban regions, considerably altering the policy landscape. These policies, plans and measures are intended to reinforce one another and hopefully foster synergies among stakeholders. The Paris Agreement, agreed upon and adopted in 2015, detects the urgency for adaptation and mitigation actions in response to climate change, highlighting that local action is needed within the international cooperation framework (Magnan & Ribera, 2016). Prior to the adoption of the Paris Agreement, the UN's Sustainable Development Goals (SDGs) were established within the 2030 Agenda for Sustainable Development. This initiative forms the groundwork to '*make cities and human settlements inclusive, safe, resilient and sustainable*' (UN, 2015a), aiming to significantly increase resilient cities globally (UN, 2015b). The unprecedented pledge of global leaders to participate in this initiative and take urgent action has been welcomed by the scientific community and the public, with specific objectives being detailed and ratified in the New Urban Agenda in late 2016 (UN-Habitat, 2016). The world leaders agreed to develop investigations of urban vulnerability and adaptation actions at the city level, integrating facets of climate change into their planning processes. The Global State of National Urban Policy (UN-Habitat, 2018) first monitored and evaluated national urban policies (NUPs) from 150 countries. The report builds on previous work by the UN-Habitat and the Organisation for Economic Cooperation and Development (OECD) and defines a common methodology. It is a noteworthy contribution to the monitoring and implementation of the SDGs and the New Urban Agenda that represents an attempt to conceive better and more sustainable cities where all citizens '*have equal rights and access to the benefits and opportunities that cities can offer*' (UN-Habitat, 2016). Moreover, it contributes to the National Urban Policy Programme (NUPP), a global initiative launched by the UN-Habitat, OECD and Cities Alliance at the Habitat III Conference in 2016, which aims to expedite the development of NUPs across the globe. While scientists and the public welcome the pledge of world leaders to urgently address the challenges of climate change, reservations accompany such promises, as adopting an international framework cannot automatically translate to action. That is evident by findings of an analysis on the development of 147 local adaptation plans in Europe, indicating that the UNFCCC process had prompted the realisation of only 21 of these (Aguiar et al., 2018). Moreover, until recently, in the EMME region, several countries lacked mandatory building energy codes, signalling the build-up of legacy infrastructure that did not meet any minimum performance requirements (IEA, 2022). To meet the conditions of the SDGs by 2030, mandatory building energy codes must be enforced in all countries, new construction should be highly energy and resource-efficient, and existing stock should undergo deep energy renovation to achieve at least a 30–50% improvement in required energy intensity (IEA, 2020a). Nevertheless, this is a challenging task on the legislative, implementation and monitoring fronts, as well as the behaviours of investors and consumers.

Policies and regulations in North Africa

Egypt

In 2012, Egypt adopted the National Energy Efficiency Action Plan for the electricity sector for the period 2012-2015. The plan was updated between 2018 and 2020 in the context of the Integrated Sustainable Energy Strategy 2035, with energy efficiency and renewable energy standing out as the two pivotal components (IRENA, 2018). The new strategy reinforces existing energy efficiency standards, expands appliance labelling and promotes the application of building energy performance codes and energy-efficient lighting. Green building standards and codes to secure long-term energy conservation across residential, commercial and public buildings have already been developed, but no concrete policies and measures exist to enforce these (Bampou, 2016). Fuel poverty, institutional barriers, economic constraints, an underdeveloped market and local governance weaknesses are hurdles to achieving indoor thermal quality and exploiting the potential of energy conservation. Egypt's Third National Communication under the UNFCCC (Egyptian Environmental Affairs Agency (EEAA), 2016) presents actions and policy instruments for mitigating greenhouse gas (GHG) emissions in the building sector and revises building codes and infrastructure standards, but mentions no rules, regulations or laws enabling such measures. Additional measures are also presented in Egypt's National Strategy for Adaptation to Climate Change and Disaster Risk Reduction (Egypt's Cabinet Information and Decision Support Centre (IDSC), 2011).

Policies and regulations in the Middle East

Israel

Israel has paid significant attention to GHG emissions from the built environment, which is responsible for 60% of Israeli electricity consumption and 33% of total GHG emissions (Ministry of Environmental Protection, 2020). In 2010, the government issued the first National Plan for the Reduction of GHG emissions in the context of Government Resolution 2508 (Ministry of Environmental Protection, 2019; The Government Secretariat, 2010). Meanwhile, Government Decision 1403, issued in April 2016 (Ministry of Environmental Protection, 2019), formulated the long-term goals of reducing energy consumption in buildings and GHG emissions through energy regulations and the labelling of new buildings as well as existing ones that had been maintained and renovated. It also promoted mechanisms and the steps required to meet the green building standards and discussed the feasibility of creating best-practice examples of green buildings in the educational and public sectors (Ministry of the Environmental Protection, 2018). Green buildings have been one of the main pillars of Israel's policies to reduce GHG emissions and raise energy efficiencies in the building sector. They feature prominently in the Third National Communication on Climate Change (Ministry of Environmental Protection, 2018), which states that the potential reduction in GHG emissions by decreasing electricity consumption in buildings and industries is estimated at 7.1 million metric tonnes of carbon dioxide equivalents (tCO_2-eq) relative to the 2030 business-as-usual scenario. That would correspond to 29% of the total reduction needed to comply with the target, also bringing about significant direct savings to the economy (Ministry of Environmental Protection, 2018). Israel's National Plan for implementing the Paris Agreement (Proaktor et al., 2016) refers to Government Decision 1403 and the Green Building Standards promoting energy efficiency in the building sector. Israel's main green building standards are SI 5281 about sustainable buildings, SI 5282 about the energy rating of buildings and SI 1045 on thermal insulation of buildings. They establish minimum requirements for various green building components to be considered in the design and the choice of construction materials and active heating and cooling systems. In 2011 and 2016, standard SI 5281 was revised, motivated by the fact that while the Israeli standard had become increasingly established, it was not uncommon for buildings to seek certification from other international rating systems, particularly the US Green Building Council's Leadership in Energy & Environmental Design (LEED) (Ben-Hur, 2014; Ministry of Environmental Protection, 2020).

Jordan

Jordan faces two main challenges regarding its energy situation: the growing energy demand and the very limited domestic resources to fulfil it (energypedia, 2018a). In the construction sector, several building codes have been developed by the Royal Scientific Society under the authority of the Jordan National Building Council since 2010 (Awadallah et al., 2009), several of which now relate to the energy efficiency of buildings. Some examples include the Thermal

Insulation Code and Manual, Jordan Green Building Guide, Natural Ventilation Code, Energy Efficient Buildings Code and Manual and Solar Energy Code and Manual (Royal Scientific Society, 2020). In terms of climate change action, in Jordan's Third National Communication on Climate Change, energy use and GHG emissions in the building sector are summarised under 'other sectors' (Ministry of Environment and United Nations Development Programme, 2014). Emissions from the 'other sectors' category account for 13.8% and 10% of the energy-related GHG emissions and Jordan's total GHG emissions, respectively. Although this represents a moderate contribution to the national GHG emissions, the building sector accounts for more than 60% of total electricity consumption. Moreover, Jordan is highly reliant on imports of energy resources (more than 96%), with very little deployment of renewables (less than 1% of electricity generation). Energy is central to the growth of the Jordanian economy, but its reliance on energy imports strains the economy and poses energy supply security risks. These vulnerabilities drove the development of the 2007–2020 Master Energy Strategy, which called for greater utilisation of domestic resources, including renewable energy. The share of electricity from renewables in Jordan grew from 0.7% in 2014 to over 14% in 2020. The updated 2020-2030 Master Strategy for the Energy Sector calls for a sustainable future energy supply, diversification of the national energy mix and increased dependency on domestic energy resources (Chang., 2021). The strategy targets a 31% share of renewables in total power generation capacity and 14% of the total energy mix by 2030. Regarding mitigation strategies, a proposed energy conservation project foresees the insulation of walls and roofs in 35,000 new houses (Ministry of Environment and United Nations Development Programme, 2014). However, these are just general policy recommendations without any specific requirements. The Second National Energy Efficiency Action Plan for Jordan addressed six sectors and included more than 30 energy efficiency measures, such as the installation of 30,000 solar water heaters, improving energy efficiency in the water sector, street lighting, transport, roof insulation and others. In summary, the energy efficiency challenges in Jordan's building sector are mainly related to unclear responsibilities in the implementation of these measures, and a lack of capacity building and compliance measures for the existing building codes (meetMED, 2020a).

Lebanon

Energy efficiency in light of GHG mitigation was addressed in Lebanon's Second National Communication to the UNFCCC (Ministry of Environment, 2011), referring to the standards for energy-efficient buildings as outlined in the 'Capacity Building for the Adoption and Application of Thermal Standards for Buildings' project. This was initiated in 2005 by the General Directorate of Urban Planning and the United Nations Development Programme, but these standards are not mandatory. The report also states that full implementation would lead to substantial energy savings estimated at around 7 million tCO_2-eq between 2010 and 2029, or around 343,500 tCO_2-eq per year (Ministry of Environment, 2011). Retrofitting the existing building stock has also been identified as a priority. The second National Energy Efficiency Action Plan (NEEAP) states that the share of energy consumption of residential buildings in the total final energy consumption was estimated to be less than 25% in 2010 (Lebanese Center for Energy Conservation (LCEC), 2016). The Lebanese Standards Institution has issued several guidelines on the thermal performance of buildings (mainly related to the demand for space cooling during summer months) and thermal insulation, as well as the calculation methodology of building components and elements (Lebanese Center for Energy Conservation (LCEC), 2016). Another proposed measure is the implementation of a dual-purpose testing facility: to test the thermal properties of different components of a building, offer certification and promote research and development of novel materials with higher energy efficiencies (Lebanese Center for Energy Conservation (LCEC), 2016). Moreover, several measures have been proposed in the 2016–2020 NEEAP (Lebanese Center for Energy Conservation (LCEC), 2016), including the drafting and application of a building code, the extensive use of energy-efficient equipment in buildings and the introduction of an Energy Performance Certificate for buildings. Further measures include conducting energy audits and implementing energy efficiency measures in public buildings, conducting a pilot project in energy efficiency measures and enhancing capacity building for refurbishments. Regarding end-use measures in the public sector, the 2016–2020 NEEAP measures recommend the adoption of green procurement for new and existing public buildings to reduce their energy consumption through increased uptake of energy-efficient products (Lebanese Center for Energy Conservation (LCEC), 2016).

Palestine

Palestine represents a very complex area divided into two administrative regions, with a population of 4.7 million inhabitants, which causes various limitations to the development of infrastructures and policies in the energy sector. In 2018, Palestinian households consumed about 45% of the country's final energy consumption, which included energy use for space heating and cooling (meetMED, 2020b). The energy sector in Palestine depends almost entirely on energy imports, with 89% of the total electricity supply coming from Israel and 3% from Egypt and Jordan. Energy capacity is essentially fossil-fuel-based; however, Palestine strives to achieve the target of 12% domestic electricity generation from renewable energy sources by 2030 (meetMED, 2019). In 2012, the European project MED-ENC developed the first NEEAP for Palestine, listing actions such as the preparation of national green building guidelines and associated codes and building a national awareness programme on energy efficiency and the use of renewables in buildings (Khatib & Becker, 2012). It also proposes the promotion of energy efficiency and renewable energies in buildings through Energy Performance Certificates and human resources capacity building in energy efficiency in the building sector. In the same year, the Palestinian Energy and Natural Resources Authority launched the Palestine Solar Initiative to promote the installation of photovoltaic panels and to install on-grid residential rooftop solar systems with a nominal installed capacity between 1 and 5 kW_p in 1000 houses. While there are plans to build an energy-efficient demonstration building near Bethlehem, at present, there are no energy-efficient buildings to be found in Palestine (meetMED, 2020b). A second NEEAP was adopted in 2016 with an ambitious energy efficiency target to reduce total electricity consumption by 500 MWh per year (Worldbank, West Bank, & Gaza Energy Efficiency Action Plan for 2020-2030, 2016). There is currently no independent entity responsible for defining and implementing energy efficiency measures in buildings. Specifying such measures is hampered by limited data availability and the absence of a dedicated survey that can collect information on the status of energy efficiency in buildings and their current requirements. Moreover, implementing a follow-up and monitoring mechanism to evaluate the impact of these measures is largely missing (meetMED, 2020a). Mitigation measures addressing the energy consumption in the built environment are scarce and include only strategies oriented to 'implement energy efficiency measures to reduce consumption and hence imported energy' (Smithers et al., 2016). The energy dependency on neighbouring countries, the weak enforcement of existing regulations and the low knowledge and capacity of public and private stakeholders are some of the main barriers Palestine faces to successfully promoting energy efficiency in the building sector (meetMED, 2020a). At the moment, the humanitarian and housing crises caused by the Israel-Palestine conflicts overshadow the challenges towards energy efficiency and adaptation to climate change, with consequences yet to be assessed.

The Syrian Arab Republic

While currently undergoing major transitions in the context of the ongoing armed conflict, the Syrian Arab Republic issued its first regulations towards energy efficiency in the built environment before these challenging times (Meslmani, 2010). The country identified several measures to address the impacts of climate change on energy needs and the improvement of energy efficiencies in the built environment (Meslmani, 2010). These include conservation measures in all residential areas, including behavioural changes, development of alternative heating devices (e.g. solar water heating systems), increase in the share of solar energy for water and residential heating, reflective roofs for buildings and use of efficient lighting. Other priorities include thermal insulation in buildings to reduce energy consumption for space heating and cooling and improve the efficiency of air conditioners and refrigerators. However, due to the devastating war in the country, little progress has been made, and information on ongoing measures and activities enhancing energy efficiency is limited. The contribution of renewables to the energy supply remains minimal, while fossil fuels provide the major share (IEA, 2020b).

Türkiye

Türkiye introduced plans for new building sector regulations in 2010 (Ministry of Environment and Urbanisation, 2023), introducing an 'Energy Identity Certificate' for new buildings, creating the infrastructure for the introduction of a similar certificate for existing buildings and deploying thermal isolation and other energy efficiency measures. Energy management in compliance with international standards was also introduced, both for the industrial and building sectors, carried out by certified energy managers. In terms of sectoral energy consumption, the buildings and services sector accounts for 37% of the total energy consumption in Türkiye (Ministry of Environment and Urbanisation, 2013). This high consumption is primarily attributed to high space heating and cooling loads since 90% of the buildings in Türkiye lack sufficient thermal insulation (energypedia, 2018b). Regulations and laws about energy efficiency standards are the standard TS 825, which manages the reduction of energy needed for space heating and cooling by thermal insulation of housing and commercial buildings, and the Regulation on Energy Performance in Buildings. The latter states that buildings with more than 2000 m^2 of usable floor area will have to be equipped with a central space heating system, while for buildings having more than 20,000 m^2 floor area, space heating and cooling will have to be driven through renewable energies and co-generation facilities (energypedia, 2018b). Regulations have been specified in the 2011–2023 National Climate Change Action Plan of the Ministry of Environment and Urbanisation (Ministry of Environment and Urbanisation, 2011), with several additional regulations being specified in the 2012–2023 Energy Efficiency Strategy Paper. Despite these laws and regulations, there are presently no incentives to support energy efficiency measures in buildings. Since fossil fuels provide most of the energy requirements in the building sector (Ministry of Environment and Urbanisation, 2011), it is not surprising that Türkiye's Nationally Determined Contributions are classified as 'critically insufficient' in the context of the UNFCCC's Paris Agreement (Climate Action Tracker, 2021).

Policies and regulations in the Arabian Peninsula

Bahrain

The Kingdom of Bahrain is the smallest oil producer among all the members of the Gulf Cooperation Council, and its oil and natural gas resources are governed by the National Oil and Gas Authority (U.S. Energy Information Administration, Analysis, 2020). Oil comprises about 85% of Bahrain's revenues. Bahrain employs nearly 4 MW of installed electricity generating capacity, consisting mainly of five relatively efficient natural gas-fired units. Electricity demand is fast growing, fuelled mainly by population growth, the need for electricity for seawater desalination and the expansion of the industrial sector. The annual *per capita* electricity consumption is one of the highest in the world and is expected to rise, while it also has one of the highest population densities globally (U.S. Energy Information Administration, Analysis, 2020;Kingdom of Bahrain, 2012 ; Kingdom of Bahrain, 2020). Meanwhile, total GHG emissions rose from 22,374 $GtCO_2$-eq in 2000 to 29,153 $GtCO_2$-eq in 2006, with the energy sector accounting for a major share, about 77% and 67% in 2000 and 2006, respectively (Kingdom of Bahrain, 2012; Kingdom of Bahrain, 2020). Bahrain holds one of the highest *per capita* GHG emissions globally, with projections for continuous upward trends. In 2013, Bahrain had double the *per capita* GHG emissions relative to that of high-income countries and approximately five-fold emissions relative to the world average (Kingdom of Bahrain, 2017). Most of Bahrain's housing stock is comprised of residences (76%), with commercial buildings accounting for around 17%. More than half of the residential sector's annual electricity consumption is related to space cooling, evident by the significant increase in electricity consumption during the summer months, a phenomenon typically observed in the entire EMME region (Kingdom of Bahrain, 2017). This increase in electricity use during extreme summer temperatures also reflects the inadequacy of building envelopes to reduce the intake of heat into the interior of a building. In November 2014, the government established the Sustainable Energy Unit under the Minister of Energy with the support of the United Nations Development Programme. The Sustainable Energy Unit launched two major initiatives: the National Renewable Energy

Action Plan (NREAP) and the National Energy Efficiency Action Plan (NEEAP) in 2017. The NEEAP identifies 22 new initiatives across all sectors to achieve a 6% reduction in energy use by 2025, relative to the average energy use over 2009–2013 (Kingdom of Bahrain, 2017). Thermal insulation regulations were introduced in 1999 with Ministerial Order No. 8, mandating all new construction over four stories to be insulated and providing minimum energy efficiency requirements for the envelopes of residential and commercial buildings, which were later expanded to include all buildings with the Ministerial Order No. 63 in 2012. The NEEAP introduced seven initiatives to improve energy efficiency in the residential and commercial sectors, including green building initiatives targeting the reduction of building energy demand and Bahrain's Building Energy Efficiency Code initiative, which was responsible for evolving the existing regulations on thermal insulation and introducing additional requirements for various systems. The NEEAP also contains the Renewable Energy Mandate for New Buildings, the National Renewable Energy Action Plan, the Building Energy Labelling Initiative and the Green Building Certification initiative, a formal certification scheme to promote the construction of resource-efficient buildings (Kingdom of Bahrain, 2017).

Kuwait

Kuwait is a global leader in the production of petroleum and oil products among the members of the Organization of the Petroleum Exporting Countries. It relies heavily on oil for electricity generation and less so on natural gas (U.S. Energy Information Administration, Analysis, 2020), with buildings being the biggest consumers of primary energy and electricity. While Kuwait had an installed electricity generation capacity of 15.7 GW, this was insufficient to meet the high summer demand for extensive space cooling in residential and public buildings. Multiple factors, such as the growing population and GDP levels, as well as low energy prices, are responsible for a rise in electricity demand within the residential sector. As a result, in 2013, Kuwait was the world's sixth-largest electricity consumer on a *per capita* basis (U.S. Energy Information Administration, Analysis, 2020). Furthermore, the country's electricity consumption has tripled in the past 30 years and is expected to rise by 20% up to 2027 and double by 2040, with most of the demand coming from space cooling (Alajmi, 2019). Due to regional conflicts, the period 1991–2008 is marked by very little progress in terms of the development of sustainable energy construction strategies, something which may be evident in the high energy demands and GHG emissions of the state (Alsayegh et al., 2018). For example, the Building Energy Conservation code was first released in 1983, and a revision with updated standards was issued in 2010 (Krarti, 2015). The update included new minimum requirements for the design and construction of new energy-efficient buildings, as well as new portions of existing buildings, including specifications for insulation of the building envelope, lighting systems, fenestration and heating, ventilation and air-conditioning (HVAC) systems (Ministry of Electricity and Water, 2016). The enforcement of the code is being carried out by the Ministry of Electricity and Water, the Kuwait Municipality and the Ministry of Public Works (Ministry of Electricity and Water, 2016).

Oman

Oman is the largest oil and natural gas producer in the Middle East (EIA, 2019), relying exclusively on diesel oil and natural gas, with electricity being generated predominantly by natural gas-fired power plants (about 97%). Although Oman has abundant potential for renewable energy generation and ambitious targets, currently, its energy portfolio includes little renewable generation and no nuclear resources. Moreover, as a result of considerable subsidisation by the government, knowledge of electricity conservation practices by consumers is very limited (Amoatey et al., 2022). Urbanisation, mainly along the coast, has increased dramatically over the past five decades in Oman. The urbanisation rate was 78.1% in 2016 (Sultanate of Oman, 2019), and electricity consumption between 2006 and 2016 grew at a fast rate, approximately tripling from 10 to 29 TWh. The peak in power demand is observed during the summertime, coinciding with extreme heat and increased space cooling demand (Charabi et al., 2014). Air conditioning makes up about 75% of the total annual energy end use in residential buildings, highlighting the need for space cooling and heating through mechanical means (Krarti & Dubey, 2017). The sultanate adopted a comprehensive National Strategy for Adaptation and Mitigation of Climate Change in October 2019 (MECA, 2019). The potential of energy efficiency measures, including improved energy management, labelling systems and strict building codes, has been investigated; nevertheless, no building codes are currently in implementation. A scenario analysis for the period 2010–2035 shows that such measures can lead to substantial electricity savings amounting to roughly 25% of electricity consumption (Sultanate of Oman, 2019). Depending on the level of measures and investments applied savings of up to 6000 GWh/a in electricity consumption and up to 1300 MW in peak power demand could be achieved (Krarti & Dubey, 2017).

Qatar

Qatar is another country that is rich in fossil fuels, considered to be the largest exporter of liquefied natural gas (LNG) globally, obtaining significant revenues from exports of petroleum products (EIA, 2015). The expansion of LNG production and economic growth have resulted in steadily rising electricity demand (U.S. Energy Information Administration, Analysis, 2020). Although the Qatar National Plan for Energy Efficiency and Resource Utilisation was launched in 2011, it said little about achieving energy efficiency in the built environment and focused more on the gas and oil industry (The State of Quatar - Ministry of Environment, 2011). A strong increase in energy demand is largely driven by population growth, changes in lifestyle and low electricity tariffs. Especially the residential sector requires substantial amounts of electricity for space cooling and appliances (The State of Quatar - Ministry of Environment, 2011), with air conditioning accounting for up to 80% of buildings' energy bills. The overall strategies to enhance energy efficiency in the country have been presented in two documents: the Qatar National Vision 2030 and, in more detail, the Qatar National Development Strategy, but only a few mandatory energy efficiency regulations in the building sector have been implemented (Meier et al., 2013). The more recent Qatar Second Development Strategy 2018–2022 (Planning and Statistics Authority, 2018) states that the enforcement of the Green Building Code by the end of 2022 will significantly reduce the *per capita* and household energy consumption. This is expected to enhance energy efficiency in the built environment (Planning and Statistics Authority, 2018), but only limited progress has been made so far. Nonetheless, in 2007, Qatar introduced the Global Sustainability Assessment System (GSAS), leading the way in the Middle East and North Africa (MENA) region for performance-based assessments and the rating of green buildings and their related infrastructure. GSAS sets out to create a sustainable built environment that minimises ecological impacts and the consumption of resources while addressing the local needs and environmental conditions specific to the region. It addresses five major environmental challenges for the countries of the Gulf Cooperation Council: (i) climate change and air pollution, (ii) fossil fuel depletion, (iii) material depletion and land contamination and (iv) water pollution and depletion (GORD, 2020). The system adopts an integrated life-cycle approach for the assessment of the built environment, and its application has addressed several significant environmental challenges in the Gulf Cooperation Council countries. On successful completion of the two stages of design and certification, the project qualifies for the final GSAS certificate. However, Ferwati et al. (Ferwati et al., 2019) claimed that the GSAS needed to be extended to the neighbourhood level in urban areas, which led to the introduction of the Qatar Sustainability Assessment System–Neighbourhood Development (QSAS-ND) assessment model. Overall, Qatar presents a state determined to introduce regulations, identify weaknesses and attempt to improve the landscape of energy-efficient buildings nationally and at the local level.

Saudi Arabia

The Kingdom of Saudi Arabia is the most extended country of the Arabian Peninsula, with copious oil and gas deposits, relying mainly on fossil fuels for energy. According to expectations, renewables will develop rapidly to support the total energy mix and provide half the nation with clean energy by 2030 (Samargandi et al., 2023). While the present *per capita* energy consumption in the Kingdom is already higher than most industrial and developed nations, the residential sector accounts for 68% of its total consumption (Al-Douri et al., 2019). Similarly to other EMME countries, HVAC systems consume the most energy in buildings in Saudi Arabia (Babelli, 2012). The government announcement on the Intended Nationally Determined Contributions to be submitted to the UNFCCC identified the buildings sector as one of the three predominant ones, collectively accounting for over 90% of the energy demand in the Kingdom (Kingdom of Saudi Arabia, 2015). The Saudi Energy Efficiency Program (SEEP) includes updated standards for thermal insulation products, the development of regulations for thermal insulation in new buildings, better control over the implementation process, updated efficiency standards for small air conditioners to match those of the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) and the development of efficiency standards for larger-capacity air conditioners (Saudi Energy Efficiency Center, 2015). SEEP defines a three-pronged approach for the erection of new buildings (Saudi Energy Efficiency Center, 2015): it specifies building material standards, defines requirements for buildings that are achievable and applicable in the Saudi context and establishes short- and long-term enforcement mechanisms employing current capabilities and international best practices. New regulations specify the minimum thermal insulation requirements for new low-rise residential buildings, defined for three distinct climatic zones in Saudi Arabia (Saudi Energy Efficiency Center, 2015). Even though SEEP measures were introduced in the early 2000s (Alyousef & Varnham, 2010), concrete progress is still limited. Mosly (Mosly, 2015) identified 14 obstacles to the development of green buildings in Saudi Arabia, including a lack of skilled personnel and unaccommodating government policies and regulations. A previous study found that the Saudi building industry has yet to understand the importance of sustainability, largely due to insufficient education and training in the construction sector, leading to a lack of appreciation for sustainability practices (Alrashed & Asif, 2014).

United Arab Emirates

The United Arab Emirates (UAE) is also one of the largest producers of petroleum and oil products globally, with almost all electricity generated in 2018 (98%) coming from natural gas (U.S. Energy Information Administration, Analysis, 2020). The building sector contributes significantly to national energy demand. In particular, residential and commercial buildings consume 65% of the generated electricity, resulting in a significant carbon footprint and economic implications (IEA, 2021). The rapid demographic and economic growth pushed the electricity grid to its limits, and the installed generation capacity continues to increase to meet the high demand. The UAE's Energy Strategy 2050, launched in January 2017, aims to diversify the country's energy mix to include clean coal (12%), natural gas (38%), nuclear energy (6%) and renewable energy (solar power, wind power and biofuels, amounting to 44%). The strategy includes an ambitious target of a 40% reduction in energy consumption across three main sectors, namely, the built environment, transportation and industry (United Arab Emirates, 2018). The UAE took critical steps to reduce the energy intensity of its building stock, such as promoting green construction practices through local green building certifications in Abu Dhabi and Dubai. The National Green Building Codes set out specific regulations that address minimum envelope performance requirements. These include external walls, roofs and floors, glazed elements (e.g. fenestration), air conditioning design parameters (including the outdoor and indoor condition of the building), air loss from entrance and exit, air leakage, as well as energy efficiency measures for HVAC equipment and systems (Government of Dubai, 2020). Key pilot projects combining several efficiency measures in building design and landscape architecture include Masdar City in Abu Dhabi and the Sustainable City in Dubai. In 2008, the Abu Dhabi Urban Planning Council started an initiative called '*Estidama*', which is the Arabic translation for 'sustainability'. It aims to promote sustainable communities and cities by balancing four main pillars: environment, economy, culture and society. In 2010, *Estidama* released its Pearl Rating, a green building rating system that considers projects at different life-cycle stages: design, construction and operation (Abu Dhabi urban planning council, 2010). It offers three types of certifications depending on the nature of the project and builds on a five-level system, or 'pearls', modelled on the LEED certification scheme. The accumulated number of points earned determines the rating: Pearl 1 represents the minimum requirements, leading up to Pearl 5, which is the highest achievable level (Abu Dhabi urban planning council, 2010). According to an executive order, all new buildings in Abu Dhabi, built after 2010, must meet the minimum Pearl 1 rating, and all government buildings must meet the Pearl 2 rating (Meltzer et al., 2014). Meanwhile, the Dubai Integrated Energy Strategy 2030 intends to decrease energy and water use by 30% by 2030 – by 2017, its implementation had shrunk *per capita* electricity consumption by 9% (Dubai Supreme Council of Energy, 2017). Addressing the inefficient operation of existing buildings, the Dubai government sets out to retrofit 25% of its building stock by 2030; starting in 2017, it commenced the retrofit programme for about 5000 government buildings (United Arab Emirates, 2018). In 2010, the Dubai Municipality issued the Dubai Green Building Regulations and Specification, mandating minimal building efficiency requirements and an update followed in 2016, issuing the '*Al'Safat*' green building rating system for residential, commercial and public buildings and industrial facilities. In contrast to *Estidama's* Pearl Rating System, *Al Sa'fat* is not a point-based system, but a building receives certification upon fulfilling the requirements of one of its four possible levels: bronze (minimum requirements), silver, gold and platinum (highest achievable level) (Dubai Municipality, 2016). Today, both the Pearl Rating System and the *Al Sa'fat* system are mandatory (at different levels) for all newly constructed buildings, but the actual performance of structures certified with one of these systems is not publicly available. Such a step would help illustrate the benefits of green rating mechanisms in the region, showcasing the UAE's dedication towards sustainable cities in the EMME and encouraging other countries to follow suit.

Policies and regulations in Western Asia

Iran

Iran holds some of the world's largest proven deposits of oil and natural gas reserves and consumed more than 270 million tonnes of oil equivalent (toe) of primary energy in 2016. Natural gas is the primary fuel source for electricity generation (70% of total generation). The total GHG emissions for all subsectors roughly doubled in the period 2000–2010, with the energy sector accounting for roughly 80% of the emissions (Islamic Republic of Iran, 2003; Islamic Republic of Iran, 2010; Islamic Republic of Iran, 2017). Iran's energy intensity exceeds that of the MENA region and low-income countries and is almost twice as high as that of the European Union (Moshiri & Lechtenböhmer, 2015). Energy expenditure increased rapidly over the past decades, with an annual growth rate of about 4% in energy use *per capita* for the period 2001-2010 (Moshiri & Lechtenböhmer, 2015). Subsidisation policies, as well as the availability of vast energy resources, drive the alarming rise in energy consumption, with very little consideration given to matters of energy efficiency and environmental impacts. The building sector consumes about 35% of the energy used in Iran (Khodamoradi & Sojdei, 2017), and the average energy use in buildings amounts to more than twice the one in developed countries. Natural gas satisfies most household energy demands (46%), with electricity (28%) and oil products (20%) following suit. Households mainly consume fuel for space heating (71%), water heating (22%) and cooking (7%). As a result of the government's policy of substituting natural gas for oil products, the energy mix of households in Iran has changed considerably since 1990 (Moshiri & Lechtenböhmer, 2015). Energy-efficient heating systems and proper insulation techniques and materials, both for new and existing buildings, present potential areas for considerable energy savings (Moshiri & Lechtenböhmer, 2015) – proposed mitigation measures include these as well as energy efficiency standards and labelling programmes (Islamic Republic of Iran, 2017). The General Policies of Consumption Reform (2011) represents one of the most important, but aborted, initiatives introduced by the Government of Iran (Khodamoradi & Sojdei, 2017). It aimed to halve energy intensity by the year 2021 but failed to achieve its objective due to economic difficulties, including sanctions and a lack of finance, technology and expertise. The National Regulations for Buildings passed in 1991 and amended in 2000 and 2014 forms yet another legislative instrument to introduce energy savings in buildings (Moshiri & Lechtenböhmer, 2015; Omrany & Marsono, 2016), backed by the Iran Energy Efficiency Organisation (SABA) and the Iranian Fuel Conservation Organisation (IFCO), founded to promote education and training and raise public awareness. Efforts to introduce appropriate regulations and laws have had, so far, only limited success, and relatively small agencies such as the

SABA and IFCO, with restricted authority and a tight budget, are unable to cope with the scale of Iran's energy efficiency problems. The potential to save almost half of the current energy consumption in buildings exists and can be materialised, if the appropriate central authorities deploy considerable efforts (Khodamoradi & Sojdei, 2017).

Iraq

The Federal Iraq and Kurdistan Regional Government holds some of the world's largest proven crude oil reserves, and its economy depends heavily on export revenues from it; in 2018, they amounted to more than 90% of total government revenues. Between 2008 and 2018, Iraq's electricity generation grew by an average of about 8% annually, reaching an estimated 78 billion kWh, of which more than 97% came from oil and natural gas (U.S. Energy Information Administration, Analysis, 2020). Iraq's initial Nationally Determined Contribution to the UNFCCC and National Environmental Strategy and Action Plan for Iraq (2013–2017) mentioned energy efficiency, in general, and in the built environment, in particular (Republic of Iraq, 2012; Republic of Iraq, 2016), as part of its national mitigation strategy, but with far less attention than supply-side issues. The government's limited efforts to improve energy efficiency seem inadequate to alleviate the severe power crisis Iraq has been facing since 2003 (Istepanian, 2020). Technical and commercial losses of energy exceed half of the generated power, with most of them stemming from the residential sector, which is the greatest energy consumer on the demand side. Considerable potential to improve energy efficiency in Iraq exists (about 210 GWh per year by 2025), mostly in the electricity sector (World Bank, 2016). The government holds a pivotal role in developing an effective strategy to reduce energy consumption and lessen the country's dependence on fossil fuel power generation, but up to now, it has not produced a building code regulating the energy efficiency of the design, construction and operation of new and existing buildings (Istepanian, 2020). Eliminating barriers to improved energy efficiency starts with reforms of the current electricity tariffs and energy subsidy systems to provide new incentives to implement and practice energy efficiency measures in the building sector (Istepanian, 2020).

Policies and regulations in European countries

Unlike the rest of the country agglomerations presented here, European Union (EU) law governs Cyprus and Greece, requiring them to implement directives related to energy efficiency in buildings in their national laws and regulations. Specifically, two directives address the building sector: Directive 2010/31/EU on the energy performance of buildings (EPBD) and Directive 2012/27/EU on energy efficiency. Recently, these two directives were amended as part of the Clean Energy for all Europeans package (Directorate-General for Energy, 2019) in 2019 and later in October 2020 as a part of the Renovation Wave strategy (European Commission, 2020) included in the European Green Deal (European Commission, 2019). In 2021, the EU adopted Regulation 2021/1119/EU (European Climate Law), establishing a framework for achieving climate neutrality by all European Member States in 2050. In early 2023, a recast of the EPBD released as part of the 'Fit-for-55' package proposes a minimum 55% reduction in GHG emissions by 2030 and reinforces safeguards for renters and flexibilities for European countries and building owners (European Parliament, 2023).

Cyprus

Cyprus transposed both European Directives related to the energy performance of buildings mentioned above (Department of Environment, 2018) and has prepared a National Energy Efficiency Programme to achieve certain energy-saving targets. The programme includes measures relevant to the built environment, such as an increased annual renovation rate of 3% of the surface of mechanically ventilated public buildings, energy refurbishment of existing residential and commercial buildings in compliance with the minimum requirements, and the promotion of roof thermal insulation on dwellings. More recently, Cyprus adopted Law 155 (I) on the Regulation of the Energy Efficiency of Buildings, which governs the regulation of new constructions and renovation of existing ones according to the updated Directive 2018/844 (Ministry of Energy Commerce and Industry, 2020). To adhere to the European Climate law, the Republic of Cyprus submitted to the European Commission in 2022 its Long-Term Strategy for Low

Greenhouse Gas Emission Development which is currently under revision and update. Several schemes have been announced at regular intervals, promoting subsidised energy refurbishments for entire buildings or individual elements such as roof insulation and renewable energy technologies (Republic of Cyprus, 2020). Early findings on the implementation of EPBD in Cyprus showed that energy reduction by up to 60% can be achieved in ageing, inefficient housing stock (Fokaides et al., 2017). As part of the EPBD, an energy certification scheme stipulates that any building up for sale or rent should hold an energy performance certificate, informing the prospective buyers/owners of the energy performance of the dwelling. In Cyprus, the relatively transposed legislation applies to new and existing buildings, with varying levels of minimum energy performance depending on the type and status of buildings (Energy Service, 2021). According to the most recent data available, approximately 15% of all buildings (residential or not) hold an energy performance certificate, most of which are new constructions (Energy Service, 2020; Energy Service, 2021). This means that the existing building stock of the country remains highly energy inefficient, without considerable renovation. Regarding clean energy in Cyprus, electricity represents the predominant energy carrier, as a natural gas grid is lacking. Electric energy is generated almost entirely through the combustion of oil products (more than 90% of total consumption), and the rest comes from renewables (Mesimeris et al., 2020). Nevertheless, according to recent statistics, renewables contributed by more than 18% in gross final energy consumption in 2022, close to the European average (21.8%) and on track to reach the 2030 goal of 23% (Eurostat, 2023; Mesimeris et al., 2020). Solar water heaters exist in almost all buildings, boosting the country's ranking in the production of direct-use solar thermal energy (European Commision, 2019). PV-generated electricity experienced a steady increase over the past decade, and the government aims to install 'photovoltaics on every roof', although considerable deficits in energy storage infrastructure caused wastage of about 20% of the generated renewable energy (Agapiou, 2023; Eracleous, 2023; Statista, 2023). The EPBD, energy efficiency schemes and clean energy actions fall under the authority of the Ministry of Energy, Commerce and Industry, which moves forward with the transition to clean energy but still faces many institutional and legacy obstacles.

Greece

Similarly to Cyprus, Greece adopted several laws and regulations based on the current European Directives. The 2019 Integrated National Energy and Climate Plan (NECP) addresses national energy and climate objectives for 2030 and sets ambitious objectives for increasing the overall share of renewable energy sources (Hellenic Republic, 2019). According to recent reports, renewables covered approximately 22% of the gross final energy consumption in Greece in 2021 (Eurostat, 2022), while the NECP targets raising this share to 35% by 2030. The portion of electricity from renewables grew from 26% in 2017 to almost 36% in 2021, which is slightly below the corresponding average among the EU countries (37.5%) (Eurostat, 2023). According to the NECP goals, this should rise to at least 60% by 2030: the share of renewables in the building sector (space heating and cooling) should rise to 42.5% from 30.6% in 2020, and in the transport sector, it should rise from 6.6% in 2020 to 19% in 2023 (Hellenic Republic, 2019). The NECP also sets out the timeframe for putting a complete end to the use of lignite for power generation in Greece by 2028. The new Climate Act15 (L.4936/22), adopted in May 2022, obliges all municipalities, including island ones, to produce local plans for GHG emission reduction in line with the NECP. It also forbade the use of oil for power generation on the islands (unless at times of critical risk for energy supply security) starting from the 1st of January 2030. Greece supports solar photovoltaic, onshore wind power and hydropower, with a focus on hybrid plants for non-interconnected islands. Incentives exist in the heating and cooling sector, solar thermal, biomass, aerothermal, geothermal and combined heat and power (CHP) plants for self-consumption (tax relief). Renewable energy source (RES) plants below 400 kW on interconnected islands and all RES on non-interconnected islands are eligible for a Feed-In tariff, while the remuneration for the electricity generated through RES and injected into the grid is regulated by Law 4964/2022 (Rakocevic et al., 2022).

Regarding the building sector, the residential and tertiary sectors consumed 44% of the final energy in 2019 (Dascalaki et al., 2016), showing great potential for energy savings, also highlighted by the fact that more than half of the existing buildings were constructed before the adoption of the first thermal insulation regulation in 1980 (Karakosta & Papapostolou, 2023). The Greek Parliament adopted Directive 2010/31/EU in 2013 (Law 4122/2013), and since 2017, an Energy Performance Study has been obligatory for issuing building permits for new buildings or extensively renovated ones (Law 4495/2017, article 2, par. 25). The national plan aiming to promote nearly zero energy buildings (issued in August 2018) defined, among others, that a new building may be characterised as a nearly zero energy building if it falls at least under energy class A, while an existing building when it falls at least under energy class B+ (Androutsopoulos & Giakoumi, 2020). The 'Energy Savings in Households II (*Eksikonomisi kat' Oikon II*)' programme, launched in 2018, provides financial incentives for implementing energy renovation measures in households. The 'ELEKTRA' programme strengthens the energy upgrading of public buildings and the participation of Energy Service Companies, while the Green Pilot Urban Neighbourhood programme addresses energy refurbishment of social housing dwellings (EPAH, 2021).

Identified open gaps and future research directions

States of the EMME region other than the European Union's Member States lack governance by a single common framework, and each one has developed its own sets of regulations and standards applicable to the building sector. Given the diversity of the

Table 3 EMME countries and status of climate change policies

Country	Policy on building energy performance standards	Energy Performance Certificate issued (all new buildings)	Zero energy building (any implementation stage)	Policy pledge on renewable energy	Policy pledge on GHG reduction	Ratification of Paris Agreement	Policy pledge on building renovations	R&D in energy efficiency, clean energy and building technologies
Bahrain	Yes	NM	None	Yes	Yes	Yes	N/A	Yes
Cyprus	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Egypt	Yes	Yes	None	Yes	Yes	Yes	None	Yes
Greece	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Iran	Yes	NM	N/A	Yes	Yes	No	N/A	None
Iraq	None	None	None	N/A	Yes	Yes	None	None
Israel	Yes	Yes	Yes	Yes	Yes	Yes	None	Yes
Jordan	Yes	N/A	N/A	Yes	Yes	Yes	N/A	Yes
Kuwait	Yes	N/A	N/A	Yes	Yes	Yes	None	Yes
Lebanon	NM	NM	N/A	Yes	Yes	Yes	None	Yes
Oman	None	None	N/A	Yes	Yes	Yes	N/A	Yes
Palestine	NM	None	None	Yes	Yes	Yes	None	Yes
Qatar	Yes	NM	N/A	Yes	Yes	Yes	None	Yes
Saudi Arabia	Yes	NM	Yes	Yes	Yes	Yes	Yes	Yes
Syria	NM	NM	N/A	Yes	Yes	Yes	N/A	None
Türkiye	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
United Arab Emirates	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

If a policy exists without conditions, it is marked as 'Yes'; if a policy exists without being mandatory, it is marked as 'NM'. If policies are known not to exist, it is marked as 'None', and if information is not available, it is marked as 'N/A'. All 'Yes' and 'NM' fields are supported by evidence in hyperlinks, while 'None' fields are sometimes linked to external sources and the rest are provided by personal knowledge of country experts co-authoring this study portfolio of Middle Eastern, Arabic, Western Asian and European countries, finding common grounds for the whole portfolio is a difficult task. To provide a systematic framework of analysis for currently implemented policies and initiatives, as well as pledges for future climate change mitigation, a matrix is presented in Table 3. Moreover, the overall performance of each country is assessed based on the policies regarding the following themes:

policy on building energy performance standards,

Energy Performance Certificate issued (all new buildings),

zero energy building (any stage of implementation),

policy pledge on renewable energy,

policy pledge on GHG emissions reduction,

ratification of the Paris Agreement,

policy pledge on building renovations, and

research and development (R&D) in energy efficiency, clean energy and building technologies.

This policy summary highlights that the current degree of implementation of measures varies when it comes to addressing climate change in national legislation and building regulations. There are a few countries with high standardisation of the built sector and commitments towards climate change mitigation, several characterised by moderate efforts and others taking minimal action, indicating a lack of regulations and concrete commitments. The frontrunners are Cyprus and Greece, both governed by EU law, but also Türkiye and the UAE. In the case of Türkiye, it is a country that has matched all the policies and commitments made by the EU countries, although not a full member. The UAE is leading by its own example and prioritising sustainability and addressing the impacts of climate change, keeping in pace with the EU but on its terms (CAT, 2023a).

In the middle ranges, Israel is marking positively all of the fields except for the policy pledge on building renovations, indicating a high level of commitment to progress in the built environment, but not holistically considering the existing building stock. Moreover, Saudi Arabia, Bahrain, Egypt, Jordan, Kuwait and Qatar have enforced mandatory energy efficiency guidelines in the construction sector; however, most are lacking in the rest of the regulations and initiatives relative to the sector. The energy performance certificates, zero energy buildings and building renovation policies are the most often weak points for these countries. Finally, Lebanon, Palestine, Oman, Iran, Iraq and Syria are showing the least amount of commitment, largely characterised by the absence of mandatory building energy codes (except for Iran). Moreover, signs of readiness to improve this are lacking, evident by the absence of energy performance certification schemes, zero energy buildings, building renovation policies and R&D relative to the built environment. From this group, the countries marked with the least progress are those involved in ongoing or prolonged conflict, with Syria and Iraq being the worst cases; the consequences of the war between Palestine and Israel remain to be determined in the coming years. This serves as a warning sign for countries about to, or already, experiencing transient conflicts that could become chronic (Bou Sanayeh & El Chamieh, 2023). It is noteworthy that despite the diverse status quo encountered in the EMME region, all countries have expressed their pledges towards greenhouse gas emissions reduction and have signed the Paris agreement, although only one has not backed it. Iran signed the Paris agreement but has not ratified it, pledging only a moderate reduction that is deemed critically insufficient (CAT, 2023b). The reason behind this may be explained by the recent claims that the agreement will be signed if sanctions against Iran are lifted (McGrath, 2021).

Nevertheless, even among the countries that have enforced strict rules and opted for ambitious goals, the lived reality may be a different story. For instance, the catastrophic Türkiye-Syria earthquake of early 2023 has led to the loss of more than 44,000 human lives and the collapse of more than 100,000 buildings, with heavy criticism on the non-implementation of modern building codes that firstly ensure safety and then energy efficiency. Instead of building up to standard, Turkish contractors were asked to pay a fine in exchange for inadequate structural quality (Azak, 2023; Bilginsoy & Fraser, 2023). On the Syrian side, renovation works are delayed or abandoned – a result of the existing neglectful construction sector which has been exploiting granted permits to build additional storeys or intervene without the appropriate considerations for safety and regulations (Housing Land & Property Rights, 2023). Another very recent example of life-threatening and infrastructure-damaging conditions is met in Greece, which has suffered devastating damages due to extreme weather conditions. Nature was once again the driving factor for this disaster, and as in the case of the Türkiye-Syria earthquake, appropriate implementation of policies and preparedness could have possibly mitigated damages (Elissaiou, 2023). On an analogous negligent tone, although creating less precarious situations, construction practices in Cyprus promote low-cost and resource-heavy solutions rather than systemic, sustainable ones. In this case, renovated buildings may be equipped with more insulation material to meet minimum energy performance standards rather than integrate renewables (MECI, 2021). Three of the best performers in terms of climate change policies are therefore found laden with flaws and faults, and it becomes evident that while commitments are a solid first step, they must be followed by actions. On the offside, Lebanon stands out with a policy response that embraces renewables and promotes energy independence, resuscitating the country's ailing electricity sector. The destructive explosion in Beirut in the summer of 2020 led to diminished power supply capacity, which still has not been recovered. In December 2023, the Lebanese government passed the Decentralized Renewable Energy Law, allowing peer-to-peer renewable energy trading and boosting energy security through the uptake of renewables (Lebanese Center for Energy Conservation (LCEC), 2023). This initiative comes from a country ranked in the lower classes of international commitment in the context of this study, highlighting that action can be a more robust solution than commitment.

Although this study focuses on selected climate change policies related to the built environment, it would be heedless to disregard the protracted refugee – and consequently – housing crisis that hinders equity and development of a sustainable built environment in the EMME region. Up to now, this is especially the case for Syria, as well as the countries that are receiving Syrian refugees, primarily Türkiye. By 2022, over 6.5 million Syrians fled the country and sought asylum in other parts of the world, creating a dual calamity: deserted homes in Syria and inadequate new housing elsewhere (WorldBank, 2023b). Syria alone represents over 25% of the global refugee population and has the lowest GDP *per capita* of all the studied EMME countries, at 537 USD (the world average is around 11,000 USD) (WorldBank, 2023a). On the other hand, Türkiye, Jordan, Palestine and Lebanon are being asked to provide adequate temporary shelter and possibly permanent housing for approximately 39% of the global refugee population (WorldBank, 2023c). These countries, too, have low GDP *per capita*, below the world average (WorldBank, 2023a). In addition to the extreme threats against human well-being, such significant numbers of transient populations create impactful disturbances to countries of origin and asylum alike. The new humanitarian and housing crisis caused by the Israel-Palestine conflict is expected to further exacerbate systemic societal disruptions in the area.

Synthesising the information collected in this study, the EMME region appears as a fragmented multi-ethnic agglomeration of countries; their efforts in climate change mitigation show different trajectories but a common goal. Even tormented states such as Syria and Palestine have recognised the urgency for coordinated long-term efforts to tackle climate change and its negative impacts. Nevertheless, the fact remains that each state operates within its capabilities and constraints. Warfare has, on occasion, hindered progress, whereas, on others, economic growth has accelerated it in an unsustainable manner. Leaders of EMME states should consider the development of unified strategies that ensure a baseline in terms of regulations over the built environment, flexible enough to accommodate both the slower and faster pacers of the region. Taking an example from European governance and Directives related to energy efficiency and building performance, a framework of building energy codes would ensure a minimum level of efficacy. Moving on from the policy scene, this would allow for research also to advance and deliver meta-analyses on the assessment of policies, as has been done for the European legislation.

Conclusions and good practices

Although most countries of the Eastern Mediterranean and Middle East (EMME) participate in and embrace international agreements, they act individually and not collectively. The energy and climate change policy landscape of this region is disorganised and lacks a backbone, confirming the initial hypothesis that the policy agenda reflects the diverse characteristics of the region. Intense urbanisation and climate change in the EMME region put millions of people at risk, with the most vulnerable having to endure the greatest impacts. Geographic, socio-economic and socio-political conditions affect the vulnerability of residents, whether that is in remote areas or dense urban centres. This paper identifies political and geographical features unique to the EMME region, linking them to socio-economic conditions. There is a stark contradiction in individual and national prosperity between the oil-rich countries of the Middle East and those with no significant hydrocarbon reserves. Cultural diversity in terms of ethnicity, religion and language often results in warfare, although competition for natural resources might be one of the underlying causes of conflict.

The diverse built environment across the region is often influenced by externalities, as well as internal prioritisation of other sectors of the economy. The new norm reflects profuse urbanisation and little attention to vernacular architecture and preservation of tangible cultural heritage – over 80% of the population lives in carbon-intensive cities in 10 out of the 17 EMME countries. Keeping up with this demand requires new urban constructions of high standards, leaving behind legacy dwellings of higher traditional value unattended. Drained pools of traditional technique builders and increasing ones comprising experts in cement, glass and steel signal the abandonment of heritage dwellings and indigenous building methods. Countries wishing to reclaim them should respond quickly to the altered built landscape and skill capacities through financing the renovation of such buildings, enriching service provision in remote areas and offering capacity building for craftsmen. Moreover, energy efficiency in new and existing buildings should assume greater importance, possibly drawing inspiration from traditional building practices rather than amplifying the embedded energy of buildings and their systems.

In the policy landscape, international efforts such as the Paris Agreement or the UN's 2030 Agenda for Sustainable Development act as roadmaps for adaptation and mitigation actions. However, national and local governments hold the responsibility for the adoption and proper implementation of these proposed strategies. A quarter of the region lacks mandatory building energy codes in 2023, reflecting the poor transposition of international agreements into national laws and policies in the building sector. At the national level, each country advances on its own terms, but lacking or unevenly reported information makes comparative approaches impossible. International cooperation and common frameworks and ambitions can tackle the evident lack of homogeneity in the greater EMME region, and long-term planning and future development of the built environment can strengthen the currently weak universally pledged commitments. Whether caused by prioritisation of wealth accumulation, increased levels of competitiveness or conflict, the response of the EMME countries against the threat of climate change is inadequate. To address this chasm, a proposed framework of governance similar to the EU's directives and regulations can level the field to a minimum amount of action and allow for individual countries to move even further than the margins.

The EMME region is a work in progress in multiple facets. One is the policy landscape on the regulation of performance in buildings, with each country showing advancement at its own pace and path. Having officially recognised the criticality of climate change impacts, a set of similar objectives will ensure as much uniformity as possible while retaining the unique specificities characterising each country. The region presents unique opportunities for innovative design approaches and the application of cutting-edge building technologies merged with abiding customary practices. However, any progress should account for the well-being of the entire population. Concurrent energy, economic and humanitarian crises in the EMME and globally block inhabitable and inclusive growth and while energy sufficiency and sustainable cities are integral aspirations for the EMME region, these should not come at the expense of the voiceless.

Acknowledgements This review was motivated by the Cyprus Government Initiative for Coordinating Climate Change Action in the Eastern Mediterranean and Middle East (https://www.cyi.ac.cy/index.php/cyi/international-collaborations/cyprus-government-initiative-for-coordinating-climate-change-action-in-the-eastern-mediterranean-and-middle-east.html).

Declarations

Conflict of interest The authors declare no competing interests.

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