

Energy Efficiency and Conservation: A Comparative Analysis of Regulatory Approaches Among GCC Countries

Mayasa Bakhit Al-Meqareh 

Undergraduate student and Researcher, College of Law, Qatar University, Qatar

m.al.mejareh@gmail.com

Abstract

This paper delves into an examination of the energy efficiency and conservation policies among the states of the Gulf Cooperation Council, otherwise known as the GCC; it engages in a critical and comparative analysis of the regulatory approaches of these states, ultimately suggesting pathways for future improvement. Confronted by elevated energy consumption on a per capita basis and attendant environmental challenges that result from such high energy use, GCC states have grappled with the ongoing challenges of progressively improving the energy efficiency in their respective countries and increasing conservation efforts, placing these two at the forefront of the policy priorities of GCC states. This study aims to critically examine the diverse regulatory frameworks implemented across Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates (including measures such as building codes, appliance performance standards, and subsidy reforms), while highlighting the inherent fragmentation among these approaches. In the end, the article argues that a unified, regional framework seems necessary and could significantly improve the effectiveness of these fragmented policies. A coordinated regulatory approach that is driven and informed by data would allow GCC countries to not only make better use of energy and boost sustainability but also concurrently strengthen the role of GCC states on the global stage of energy policymaking as an example of a regional effort towards unified environmental regulation.

Keywords: Energy efficiency; Gulf Cooperation Council; Regulatory frameworks; Energy policy

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كفاءة الطاقة والحفاظ عليها: تحليل مقارنة للنهج التنظيمية بين دول مجلس التعاون الخليجي

مياسة بخيت المقارح ^{id}

طالبة بكالوريوس وباحثة، كلية القانون، جامعة قطر-قطر

m.al.mejareh@gmail.com

ملخص

هذه الورقة تتعمق في دراسة سياسات كفاءة الطاقة وترشيدها بين دول مجلس التعاون الخليجي، المعروفة اختصاراً بـ (GCC)، إذ تقدم تحليلاً نقدياً مقارنةً للنهج التنظيمية المتبعة في هذه الدول، وتنتهي باقتراح مسارات للتحسين المستقبلي. في ظل ارتفاع معدلات استهلاك الطاقة للفرد وما يترتب عليه من تحديات بيئية، واجهت دول المجلس صعوبات مستمرة في تحسين كفاءة الطاقة وتعزيز جهود الترشيد، مما جعل هذين الهدفين في صدارة أولويات السياسات الوطنية لدول الخليج. تهدف هذه الدراسة إلى فحص الأطر التنظيمية المتنوعة المطبقة في البحرين، والكويت، وعمان، وقطر، والمملكة العربية السعودية، ودولة الإمارات العربية المتحدة (بما يشمل تدابير مثل أكواد البناء، ومعايير أداء الأجهزة، وإصلاحات الدعم)، مع إبراز التشتت الكامن بين هذه السياسات. وفي الختام، تجادل الورقة بأن وجود إطار موحد على المستوى الإقليمي يبدو ضرورياً، ويمكن أن يعزز بشكل كبير فعالية هذه السياسات المتفرقة. إن تبني نهج تنظيمي منسق قائم على البيانات من شأنه أن يمكن دول مجلس التعاون من تحسين استخدام الطاقة وتعزيز الاستدامة، وفي الوقت ذاته تقوية دورها على الساحة العالمية في صنع السياسات الطاقية، كنموذج للجهود الإقليمية نحو تنظيم بيئي موحد.

الكلمات المفتاحية: كفاءة الطاقة، مجلس التعاون الخليجي، الأطر التنظيمية، سياسة الطاقة

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Introduction

In an era of severe environmental challenges, energy efficiency and conservation are vital for reducing carbon emissions and fostering sustainable development, especially through energy-saving policies.¹ The Gulf Cooperation Council (GCC) countries—Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the UAE—have thrived on abundant hydrocarbon reserves, driving rapid growth in population and infrastructure.² However, this reliance on oil and gas has led to high per capita CO₂ emissions, fueled by economic growth, fossil fuel access, urbanization, population growth, and energy subsidies, raising concerns about energy security and sustainability.³

The GCC has responded with regulatory measures like strict building codes, appliance standards, and gradual subsidy cuts, though approaches vary due to differing national priorities, economies, capacities, and laws.⁴ For instance, the UAE's robust green regulations and renewable investments contrast with other states' context-specific strategies.⁵ This paper compares these approaches, with Part II outlining consumption patterns and environmental impacts, Part III analyzing regulations, Part IV assessing successes and challenges, and Part V proposing a coordinated regional framework to enhance policy effectiveness.⁶

This study uses a mixed-methods comparative approach that combines both quantitative and qualitative indicators to look at how well energy efficiency policies and regulations work within the Gulf Cooperation Council (GCC) countries. The quantitative part uses measurable standards such as energy use per person, building insulation (U-value) benchmarks, air conditioning efficiency ratios (EER, SEER), and carbon emissions data arising from the most recent regional data and international reports.⁷ These give us objective ways to compare countries and see how policies are changing over time.⁸

1 S Shao and others, 'How do energy-saving policies improve environmental quality: Evidence from China's Top 10,000 energy-consuming enterprises program' (2024) 175 *World Development* 106466.

2 S Hertog and G Luciani, 'Energy and Sustainability Policies in the Gulf Cooperation Council (GCC)' (Oxford Energy Forum 2009).

3 TZ Ahmed and others, 'A review of electricity consumption and CO₂ emissions in Gulf Cooperation Council households and proposed scenarios for its reduction' (2024) 42 *Arab Gulf Journal of Scientific Research* 1882.

4 International Energy Agency, *World Energy Outlook* (2023); MI Khan and others, 'The GCC's Path to a Sustainable Future: Navigating the Barriers to the Adoption of Energy Efficiency Measures in the Built Environment' (2024) 23 *Energy Conversion & Management: X* 100636.

5 Khan (n 4) 3.

6 Hertog and Luciani (n 2); M AlKhars and others, 'A Systematic Review of the Relationship Between Energy Consumption and Economic Growth in GCC Countries' (2020) 12 *Sustainability* 3845.

7 MAM Sallam and T Sadraoui, 'Energy efficiency and industrial competitiveness: Case study of the GCC region using CS-ARDL and PMG-ARDL approach' (2025) 15 *International Journal of Energy Economics and Policy* 454.

8 Hertog and Luciani (n 2); K Dubey, 'Energy Efficiency Policies and Initiatives in the GCC: Progress and Challenges' (UNECE 2016) <http://unece.org> accessed 27 April 2025.

The qualitative part examines regulatory frameworks, implementation challenges, institutional capacity, and stakeholder adherence to the rules. This is in addition to the quantitative study. The analysis uses a systematic review of current policy requirements and new research on energy efficiency and sustainability. For example, Khan et al. talk about how the structure of governance and public acceptance can help make improvements across the board. On the other hand, ESCWA and KAPSARC⁹ suggest using qualitative benchmarks to assess how effectively policies are being enforced and how well organizations are collaborating.¹⁰

The choice of both quantitative and qualitative measures used to be carefully explained so that a full assessment could be made. We chose quantitative indices on account of they can show objective gaps and strengths within each country's energy environment. We chose qualitative criteria because they can show the core reasons for implementation problems, including regulatory fragmentation or market resistance. This two-track approach follows best practices for mixed comparative analyses within energy policy research. It makes sure that the comparative insights not only show what works, but also explain why some policies work or don't work within the GCC environment.

The analytical method went as follows:

1. Data Collection: Getting official numbers on energy use, emissions, policy papers, and studies that have been peer-reviewed.^{11,12}
2. Indicator Mapping: Finding and organizing quantitative performance measures and qualitative implementation themes that are significant, based upon recent academic and policy literature.
3. For quantitative comparison, we used econometric methods such as CS-ARDL and PMG-ARDL. For qualitative assessment of regulatory approaches and hurdles, we used theme analysis.¹³
4. Synthesis and Interpretation: Putting together the results to show how effective policies are, where they fall short, and what works best within all GCC countries.

1. Energy Consumption Patterns and Environmental Implications in the GCC

The GCC countries, representing just 0.5% of the global population, consume about 5% of the

9 ESCWA and KAPSARC, *Unlocking Energy Efficiency in the GCC Built Environment* (Regulatory Policy Standard 2024).

10 MI Khan and others, 'The GCC's path to a sustainable future: Navigating the barriers to the adoption of energy efficiency measures in the built environment' (2024) 23 *Energy Conversion and Management*: X 100636.

11 GCC Statistical Center, *2024 Report on Measuring General Trends of the Sustainable Development Goals Indicators for GCC Countries* (2025).

12 ESCWA and KAPSARC, *Unlocking Energy Efficiency in the GCC Built Environment* (Regulatory Policy Standard 2024).

13 M Elhaj, 'Do energy efficiency and technology boost sustainable environment: Evidence from GCC countries' (2024) 3 *Journal of Ecohumanism* 2545.

world's oil, leading to some of the highest per capita energy use globally.¹⁴ This stems from rapid economic growth, urbanization, population growth, and heavily subsidized energy prices, with cheap fuel, often cheaper than bottled water, encouraging wasteful consumption, as noted by Al Maamary et al.¹⁵ Between 2000 and 2009, domestic petroleum use grew by 6.5% annually, with Qatar at 13% and Saudi Arabia using 26.5% of its output domestically. Per capita electricity use rose 6.2% yearly from 1971 to 2012.¹⁶

This increase, driven by economic, regulatory, and infrastructural factors, including extreme climate necessitating air conditioning, has severe environmental effects.¹⁷ Qatar led in per capita CO₂ emissions in 2021, with other GCC states following, due to rapid development and fossil fuel reliance. Electricity and desalination sectors dominate emissions, with the UAE's energy sector causing 90% of its GHG emissions and Kuwait's from electricity, transport, and oil, leading to air pollution and ecosystem harm.^{18, 19}

Economically, the GCC's 39% GDP and 83% government revenue reliance on oil and gas in 2008 heightens vulnerability to global market shifts.²⁰ This heavy dependence on hydrocarbons, combined with energy inefficiency, poses significant challenges, underscoring the need for diversification and efficiency improvements to mitigate both environmental and economic risks.²¹

Beyond environmental concerns, the reliance on fossil fuels for energy production and energy inefficiency has economic consequences. The GCC economies heavily rely on hydrocarbons, with oil and gas contributing 39% to GDP and 83% of government revenues in 2008. The heavy dependence on oil and gas revenues makes GCC countries vulnerable to fluctuations in global energy markets.

The GCC faces energy security and environmental challenges due to fossil fuel depletion and carbon emissions.²² High domestic energy consumption reduces the volume of hydrocarbons available for export, potentially affecting national revenues. Additionally, the environmental degradation associated with high energy use poses risks to other critical economic sectors, such as tourism and fisheries, which are vital for economic diversification efforts.

14 HMS Al-Maamary, HA Kazem and MT Chaichan, 'Changing the energy profile of the GCC states: A review' (2016) 11 Int J of Applied Engineering Research 1981.

15 Ibid 1982.

16 Ibid.

17 M AlKhars and others, 'A Systematic Review of the Relationship Between Energy Consumption and Economic Growth in GCC Countries' (2020) 12 Sustainability 3845; M Osman, G Gachino and A Hoque, 'Electricity Consumption and Economic Growth in the GCC Countries: Panel Data Analysis' (2016) 98 Energy Policy 318.

18 Our World in Data, 'CO₂ Emissions Per Capita by Country' (2025) <https://ourworldindata.org/co2-and-greenhouse-gas-emissions> accessed 27 April 2025.

19 Khan (n 4) 3.

20 Al-Maamary (n 14) 1986.

21 Climate Watch, 'Kuwait Climate Change Data Emissions and Policies' (2025) <https://www.climatewatchdata.org/countries/KWT> accessed 27 April 2025; Al-Maamary (n 14) 1982.

22 Al-Maamary (n 14) 1983.

Recent research shows disturbing energy use patterns within Gulf Cooperation Council (GCC) nations, alongside per capita figures much above worldwide norms. The energy dynamics for the area reveal unique trends that require quick policy focus.

GCC states dominate global rankings for energy use per capita, as demonstrated in Table 1:

Table 1: 2023 Energy Consumption Metrics

Country	Energy/Person (TOE)	Electricity/Person (MWh)	Global Avg (TOE)
Qatar	19.3	18.51	1.9
UAE	15.1	15.50	1.9
Saudi Arabia	12.7	12.71	1.9
Kuwait	17.7	17.68	1.9
Bahrain	23.1	23.05	1.9
Oman	8.9	8.91	1.9

TOE = Tonnes of Oil Equivalent; Data source: IEA²³, GCC-STAT²⁴.

Qatar's energy consumption, driven by intense cooling needs and energy-heavy industries, is 34 times the global average, while the UAE and Saudi Arabia use 8-12 times more than similar high-income, hot-climate countries.²⁵ GCC energy demand evolves in three phases²⁶: household air conditioning (67% of demand) grew 4.2% annually (2015-2020), industrial intensity rose 8.1%, and post-pandemic recovery saw 6.3% growth (2021-2023), with Saudi Arabia using 33% of its oil domestically.²⁷ Despite fossil fuels dominating 89% of the mix, growth may slow to 3.1% (2024-2025) with increased renewables.²⁸

Water security challenges the GCC's water-food-energy nexus, with desalination meeting 90% of water needs at 15 kWh per cubic meter, consuming 1.5 million barrels of oil daily in Saudi Arabia (8.7% of exports).²⁹ Agriculture, using 79% of freshwater, contributes only 2% to GDP, while Qatar's irrigation costs 42% above the global average at 4.7 kWh per cubic meter.³⁰

Table 2: GCC vs Global Resource Use(2023)

Metric	GCC Avg	Global Avg	Ratio
Energy Use/Person (TOE)	18.7	1.9	9.8:1
CO2 Emissions (t/person)	21.4	4.7	4.6:1
Energy for Water (%)	12	4	3:1

Data sources: World Bank (2023), UNEP (2023)

23 International Energy Agency, World Energy Balances 2023 (IEA 2023).

24 GCC-STAT, GCC Energy Indicators Report (Gulf Cooperation Council Statistical Centre 2023).

25 GCC Energy Centre, Annual report on GCC energy demand trends (GCC Secretariat General 2021).

26 OPEC, World Oil Outlook 2023 (Organization of the Petroleum Exporting Countries 2023).

27 IRENA, Renewable energy integration in the GCC (International Renewable Energy Agency 2022).

28 KAPSARC, Multiple Benefits of Building Energy Efficiency in Saudi Arabia (King Abdullah Petroleum Studies and Research Center 2019).

29 Food and Agriculture Organization, Agricultural water use efficiency in arid regions (FAO 2022).

30 Ministry of Environment and Climate Change, Qatar's national water and energy statistics (MOECC 2023).

GCC consumption trends highlight three strategic concerns. First, economic vulnerability: Saudi Arabia's domestic oil use may reach 8.3 million barrels daily by 2030, threatening export revenue that funds 63% of its budget. Second, climatic impact: desalination emits 76 million tons of CO₂ annually, matching Portugal's total emissions. Third, resource depletion: without efficiency gains, the UAE and Bahrain's groundwater could be exhausted by 2045.

2. Regulatory Frameworks and Policies in GCC Countries

2.1. Comparative Architecture of GCC Energy-Efficiency Policy

In the GCC, energy-efficiency rules are built around five main parts: building energy codes, appliance standards and labels (MEPS), green-building rating systems, ways to enforce and monitor compliance, and energy pricing policies. These parts show both how ambitious the policies are and how ready each country is to apply and follow them.

Building energy codes form the primary edifice of GCC efficiency architecture. Such codes specify acceptable thermal performance for building envelopes, minimum lighting performance, and optimized HVAC specifications. Saudi Arabia's SBC 601, the R-6 Building Code of Kuwait, and the Emirati Dubai Green Building Regulations, alongside the Abu Dhabi Estidama scheme, exemplify binding instruments that set U-values for both walls and roofs, together with mandates for optimized air-conditioning seasonal efficiency.³¹ Oman, by contrast, maintains only voluntary performance indicators, delegating adherence to developers' commercial incentives. This divergence in statute reflects distinctly varying institutional capacities and the relative salience assigned to energy policy in national economic agendas.³²

Minimum Energy Performance Standards (MEPS) and associated labeling frameworks extend regulatory discipline to the appliance sector.³³ In the GCC, air conditioners dominate domestic electricity consumption; the sector thus faces binding efficiency ratios in the markets of Qatar, Saudi Arabia, Kuwait, and the UAE. Bahrain and Oman operate voluntary labeling frameworks, yet the absence of systematic audit and penalty systems weakens practical enforcement. Domestic standards increasingly align with ASHRAE and selected European Union performance benchmarks, thereby raising technical ambition, even as actual on-shelf penetration of the highest tiers of efficiency remains disappointing.³⁴

These systems broaden the regulatory lens to address water efficiency, material choice, and indoor environmental quality. Enforcement and ongoing monitoring ultimately translate the ambition into resource savings. Most UAE emirates and Qatar require energy modeling before a permit is issued; Saudi Arabia and Kuwait depend on periodic site checks, and Bahrain's Electricity and Water Authority levies

³¹ Op. cit.

³² Ibid.

³³ AlKhars (n 6) 3.

³⁴ Ibid.

finest only when the building is already occupied. Oman is yet to establish any mandatory enforcement mechanism. Comparative studies clearly link the extent of inspection frequency, the quality of data sharing, and the level of coordination among enforcement entities to observed compliance rates.³⁵

2.2. Regional Benchmarking

In the GCC, energy codes are key to improving building thermal performance, with each country adopting tailored frameworks: Saudi Arabia’s SBC 601, Kuwait’s R-6 Code, Dubai’s Green Building Regulations, and Abu Dhabi’s Estidama system mandate insulation and high-performance AC, while Oman relies on voluntary guidelines, showing the region’s widest variation.³⁶ Table 3 (2023 data) highlights Qatar’s GSAS with a strict 0.30 W/m²K U-value for walls, contrasting Bahrain’s lenient 0.75, with SBC 601 taking a moderate stance.³⁷ Qatar leads in cooling efficiency with an EER of 11, versus Oman’s voluntary 8. These differences reflect economic, political, and institutional influences, though practical benefits often fall short.³⁸

Implementation varies: Qatar and the UAE require pre-project energy modeling and certification, locking in performance targets, while Saudi Arabia and Kuwait rely on limited on-site inspections, and Bahrain imposes post-occupancy penalties, reducing preventive impact. Oman lacks statutory enforcement, leading to low compliance as developers ignore guidelines.³⁹ Subsidies in Kuwait and Bahrain further dampen the adoption of energy-saving tech, unlike the UAE and Saudi Arabia, where subsidy cuts make upgrades profitable.⁴⁰ Lessons include: strict enforcement is essential for savings; pre-project modeling with independent checks boosts compliance; and persistent subsidies undermine effective regulations.⁴¹

Table 3: Comparative Analysis of GCC Building Energy Codes (2023 Data)

Country	Wall U-Value (W/m²K)	Roof U-Value (W/m²K)	AC Efficiency (EER/SEER)	Enforcement Mechanism	Key Challenges
UAE	0.32–0.57	0.14–0.30	SEER ≥14	Estidama Pearl Certification	Fragmentation across emirates
Saudi Arabia	0.52	0.30–0.41	EER ≥10	SEEC Audits	Slow retrofit adoption
Qatar	≤0.30	≤0.25	EER ≥11	GSAS Mandatory Compliance	Private sector non-compliance
Kuwait	0.57	0.40	EER ≥9	KISR Technical Audits	Subsidy-driven overconsumption

35 Ibid.
36 Integrated Environmental Solutions, ‘IES Virtual Environment (IESVE)’ (2024) <https://www.iesve.com/software/building-energy-modeling> accessed 27 April 2025.
37 Ibid.
38 Ibid.
39 Ibid.
40 Integrated Environmental Solutions (n 36); Op. cit.
41 AlKhars (n 6).

Oman	N/A	N/A	EER ≥ 8	Voluntary Guide-lines	No mandatory code
Bahrain	0.75	0.60	EER ≥ 8.5	EWA Construc-tion Inspections	Data monitoring gaps

EER = Energy Efficiency Ratio | SEER = Seasonal Energy Efficiency Ratio

2.3. Enforcement Mechanisms

The effectiveness of energy-efficiency regulations in the GCC depends more on enforcement rigor than technical benchmarks, despite varying monitoring and penalty capacities across the six states. Enforcement includes permit modeling, on-site verification, and post-occupancy auditing. Permit modeling, as seen in Abu Dhabi's Estidama Pearl Rating System, Qatar's GSAS, and Dubai's Al Sa'fat directive, mandates energy models before permits, reducing inefficient designs and boosting compliance (e.g., 23% savings in Qatar's public facilities).

On-site verification, conducted by Saudi Arabia's SEEC and Kuwait's MEW with KISR, checks insulation and HVAC specs, but limited to 12% of Saudi projects, yields 68% compliance with SBC 601. Post-occupancy monitoring, practiced by Bahrain's EWA with penalties, covers only 10% of buildings due to poor data systems, highlighting the need for centralized registers and digital surveillance.⁴²

Dubai's Al Sa'fat directive requires performance-based calculations for licensing, preventing energy-inefficient designs, and reducing retrofit needs, with Qatar's government facilities showing 23% savings from such modeling. On-site verification, led by Saudi Arabia's SEEC and Kuwait's MEW with KISR, checks insulation and HVAC specs, but covers only 12% of Saudi projects, achieving 68% SBC 601 compliance. Bahrain's EWA imposes post-occupancy penalties, yet only 10% of buildings comply due to weak data systems, necessitating centralized registers and digital surveillance.

Oman lacks mandatory enforcement, relying on voluntary codes with under 25% compliance, despite planned 2040 legislation. GCC evidence shows enforcement success requires integrated regulatory authority, technical capacity, and public data to turn standards into energy savings.⁴³

2.4. Financing and Market Instruments

Even with robust statutory frameworks and steady compliance mechanisms, GCC-wide energy efficiency gains require tailored financing and market tools.⁴⁴ High renovation costs for pre-2010 buildings, with payback periods outlasting energy subsidies, deter private investment under low tariffs, delaying savings.⁴⁵ Pilot schemes using Energy Service Companies (ESCOs), like Dubai's Etihad ESCO

⁴² Ibid.

⁴³ UNECE, *Energy Efficiency in Buildings in the UNECE Region* (United Nations Economic Commission for Europe 2016).

⁴⁴ K Lihidheb, R Missaoui and J Shariff, 'Innovative Energy Efficiency Instruments for the MENA Region' (2020) <https://www.giz.de/en/downloads/giz2020-en-innovative-energy-efficiency-instruments.pdf> accessed 27 April 2025.

⁴⁵ AlKhars (n 6) 2.

and Saudi Arabia's Tarshid, fund retrofits and share savings, achieving over 20% energy reduction in 24 months, signaling potential for broader adoption.⁴⁶

Redirecting a small portion of hydrocarbon subsidies to incentives, such as rebates for inverter ACs or tax breaks for GSAS/Estidama buildings⁴⁷, could shorten payback periods. Qatar's Tarsheed offers an early example, though GCC-wide adoption lags. International best practices show that combining minimum technology standards with financial incentives boosts compliance and market rollout. Public-Private Partnerships (PPPs) in the UAE's district cooling and Saudi Arabia's municipal retrofits demonstrate significant savings, emphasizing that regulatory efforts alone are insufficient without financial support to address legacy inefficient buildings.⁴⁸

2.5. Country Profiles

2.5.1. Bahrain

Since 1999, Bahrain has established itself as the regional vanguard by mandating thermal insulation. The framework was subsequently reinforced in 2016 through the issuance of the National Energy Efficiency Action Plan (NEEAP) and the National Renewable Energy Action Plan (NREAP). Delegated enforcement rests with the Electricity and Water Authority (EWA), which resorts to post-occupancy financial penalties—an atypical enforcement strategy within the Gulf Cooperation Council.

Among the notable undertakings is the Kafa'a program, which targets a cumulative electricity consumption reduction of 975 GWh and an associated 488,000 tons of CO₂ mitigation by 2040. Appliance efficiency standards have been nominally harmonized with the EU Commission Regulation 244/2009 on lighting. Nevertheless, the enforcement record is deficient: by 2023, approximately 9% of the existing building stock satisfied the specified efficiency norms, a situation exacerbated by the prevalent friction of retrofitting aged properties.

2.5.2. Kuwait

Kuwait implemented its inaugural energy conservation code in 1983, subsequently overhauling it through the 2014 R-6 Code, which encompasses thermal insulation, heating, ventilation, and air-conditioning systems, and lighting standards. The Kuwait Institute for Scientific Research (KISR) coordinates comprehensive energy audits, which have consistently recorded savings on the order of 30% in facilities examined. The regulation is enforced jointly by the Ministry of Electricity and Water (MEW) and KISR, the latter conducting the technical audits necessary for validation.

46 U Al-Mulali and CN Sab, 'Energy efficiency and competitiveness in the Gulf Cooperation Council (GCC): Empirical evidence from panel data' (2021) 69 *Economic Analysis and Policy* 245.

47 SASO, ESMA and G-Mark, 'Regulatory Tightening in the GCC: New Energy Label Norms and Compliance Risks' (2025) *Law/Regulation Analysis*.

48 A Al-Badi and I AlMubarak, 'Growing energy demand in the GCC countries' (2019) 26 *Arab Journal of Basic and Applied Sciences* 488.

The ordinance has yielded tangible quantitative outcomes: commercial stock has collectively achieved an 18% curtailment in peak electricity demand relative to the pre-adoption baseline. In parallel, the 2018 rollout of minimum energy-performance standards (MEPS) for air-conditioning units was a significant complementary measure.⁴⁹

2.5.3. Oman

The Sultanate of Oman lags in the GCC for legally binding energy regulations. The 2013 Energy Efficiency and Conservation (EE&C) Master Plan, developed with JICA, outlines a strategy but relies on voluntary incentives and limited pilot projects rather than mandatory codes. Oman's Vision 2040 and Energy Master Plan 2040 aim for 30% renewable energy by 2030 and 90-100% by 2050, supported by streamlined solar permits and a wheeling arrangement. However, uptake remains low, with under 25% of developers following voluntary guidelines, reflecting weak enforcement rather than poor practice.⁵⁰

2.5.4. Qatar

Qatar has advanced with the Global Sustainability Assessment System (GSAS), a leading green building framework, rolling out mandatory compliance for public projects in 2012, commercial in 2016, and residential in 2020. Initial data shows a 23% energy use reduction in GSAS-compliant facilities compared to non-compliant ones. The Tarsheed initiative (2012) and minimum energy performance standards (MEPS) for air-conditioners (2013) support conservation. However, pervasive utility subsidies limit compliance, with only 41% of private developments certified. Policymakers are boosting verification staff and exploring incentives like tax breaks and utility tariffs tied to GSAS performance.

2.5.5. Saudi Arabia

Saudi Arabia boasts a robust energy-efficiency framework with the Saudi Building Code—Energy (SBC 601), updated in 2020, enforcing strict thermal and HVAC standards, reducing peak-cooling loads by 35% in compliant buildings. The Saudi Energy Efficiency Center (SEEC) and Saudi Energy Efficiency Program (SEEP) ensure compliance, label appliances, and educate the public. However, only 68% of new residential units fully comply, and retrofitting older homes faces technical and regulatory challenges due to institutional silos. Vision 2030 subsidy reforms are aligning financial incentives with performance goals, improving the outlook.

2.5.6. United Arab Emirates (UAE)

The UAE leads the Gulf in energy efficiency regulations. Dubai introduced mandatory thermal

49 A Esam, 'Will GCC countries be economies of the future or old oil ghost countries?' (2023) <https://blog.oxfordeconomics.com> accessed 16 January 2023.

50 A Al-Sarihi, 'Energy transition in the Gulf: Best practices and limitations' (Carnegie Endowment for International Peace 2025) <https://carnegieendowment.org> accessed 27 April 2025.

insulation in 2003 and Green Building Regulations in 2011, while Abu Dhabi launched the Estidama Pearl Rating System in 2010, both requiring energy modeling and sustainability in urban planning. Federally, the Emirates Authority for Standardization and Metrology (ESMA) enforces minimum energy-performance standards (MEPS) for lighting and appliances. However, retrofitting remains a challenge, with 57% of buildings un-audited by 2023 due to a shortage of certified assessors.

2.6. Toward Regional Harmonization

Mutual recognition of energy-performance rating systems would simplify compliance. Developers could submit one set of test results to their home jurisdiction, reducing administrative burdens across GCC states. A postal badge labeling scheme, recognizing ratings from accredited GCC schemes, would eliminate repeat labeling, speeding up projects, boosting competition among labs, lowering testing costs, and encouraging policymakers to adopt efficient technologies without duplicative compliance costs.⁵¹

Third, a coordinated surveillance initiative could strengthen performance claim integrity. Real-time sharing of anonymized post-installation data would enable early detection of non-conformance, reducing costly fixes. A collaborative oversight system, akin to advanced economies' Internal Market centers, could operate via periodic telematic workshops uniting jurisdictions, labs, and import authorities.⁵²

At present, the UAE's Estidama, Qatar's GSAS, and Saudi Arabia's Mostadam standards function in isolation, giving rise to duplicative and often conflicting obligations for developers undertaking cross-border projects. The introduction of a harmonized mutual-recognition mechanism would alleviate these compliance encumbrances and simultaneously advance uniform sustainability outcomes across the region. Under such a regime, certification obtained in one jurisdiction would be mutually accepted in the remaining states, provided that the requisite performance thresholds demonstrate functional equivalence. Regional data infrastructure. Enforcement weaknesses within the GCC jurisdiction are exacerbated by insular data capture and incomplete monitoring regimes.⁵³

High upfront costs of retrofitting buildings hinder individual GCC action. A regional green finance facility could enhance resource mobilization beyond national budgets, featuring a regional ESCO guarantee backed by sovereign wealth funds and green sukuk, funding pooled refurbishment projects. This would reduce investment risks, standardize measurement protocols, and leverage scale through joint procurement.

51 SASO, ESMA and G-Mark (n 47).

52 HMS Al-Maamary and others, 'Energy transition strategies in the Gulf Cooperation Council countries' (2024) 53 Energy Strategy Reviews 101512.

53 S Alalanan and others, 'Measuring underlying energy efficiency in the GCC countries using a newly constructed dataset' (2019) 3 Energy Transitions 31.

Percentage Reduction in Electricity Consumption in Building Sector Since Code Implementation in GCC Countries

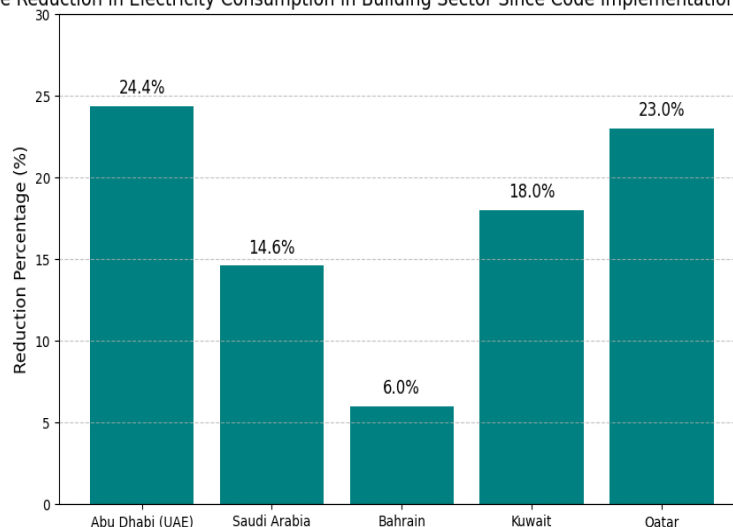


Figure 1: Percentage Reduction in Electricity Consumption in the Building Sector Since Code Implementation in GCC Countries

Figure 1 shows the percentage drop in power use within the building industry subsequent to energy efficiency regulations being applied within selected GCC nations. The figures show that Abu Dhabi (UAE) and Qatar saw the largest decreases, 24.4%, and 23%.⁵⁴

Table 4 :Regulatory Frameworks and Standards Across GCC States (2023 Data)

Country	Green Building Code	Appliance Efficiency Standards	Building Rating System	Subsidy Reforms	Renewable Energy Targets
UAE	Dubai Green Building Reg. (2011); Estidama Pearl (2010)	ESMA MEPS for ACs (SEER ≥ 14)	Estidama Pearl	2015 fuel price liberalization	44% clean energy by 2050
Saudi Arabia	SBC 601:2020 (0.52 W/m ² K walls)	SASO MEPS for ACs (EER ≥ 10)	Mostadam	Vision 2030 subsidy phase-out	54 GW renewables by 2040
Qatar	GSAS Mandatory (2019)	Tarsheed AC Standards (EER ≥ 11)	GSAS	2021 fuel price indexation	20% renewables by 2030
Kuwait	R-6 Code (2014)	MEW AC Standards (EER ≥ 9)	K-Build (Voluntary)	2022 electricity tariff reform	15% renewables by 2030
Oman	Draft Energy Master Plan 2040	DG-SM-EE-1:2023 (Voluntary)	None (JICA pilot)	2023 fuel subsidy reduction	30% renewables by 2030
Bahrain	Benayat Regulations (2019)	EWA Labels (EU-aligned)	Green Code (Developing)	2020 electricity tariff adjustment	5% renewables by 2025

⁵⁴ T Alawadh and S Al Zahmi, 'Sustainable energy policies, cities, and buildings in Gulf Cooperation Council (GCC)' in ZEMCH Network (ed), ZEMCH 2021 - 8th Zero Energy Mass Custom Home International Conference Proceedings (2021) 1036.

3. Evaluation of Policy Effectiveness and Persistent Challenges

Though the GCC nations have all sought energy efficiency and conservation, their programs' success, and the obstacles they encounter vary greatly upon account for variations within execution, economic systems, and enforcement tools.⁵⁵

3.1. Effectiveness of Implemented Policies

3.1.1. UAE

The UAE leads with the 2011 Green Building Regulations, driving energy-efficient construction in Dubai and projects like the Mohammed bin Rashid Al Maktoum Solar Park (5GW by 2030), though savings remain modest due to reliance on gas and oil.^{56, 57}

3.1.2. Saudi Arabia

The Saudi Energy Efficiency Program (SEEP) and SBC 601 reduce peak cooling loads by 35% in new buildings and shift consumer preferences via appliance standards.⁵⁸

3.1.3. Qatar

The 2013 Global Sustainability Assessment System (GSAS) achieves 23% energy reduction in public buildings, but voluntary compliance in commercial/residential sectors is low at 41%.⁵⁹

3.1.4. Kuwait

The 2014 R-6 Code cuts commercial peak demand by 18%, though enforcement is weak, especially for older buildings lacking retrofits.

3.1.5. Bahrain

The National Energy Efficiency Action Plan (NEEAP), launched in 2011, established a legal and institutional framework that mandates both thermal insulation levels and minimum energy performance requirements for appliances. Implementation milestones have been reached, but the regulatory coverage remains superficial, with only 9 per cent of the total building stock having secured the obligatory certification.⁶⁰

55 GCC Statistical Center (n 11).

56 Dubai Electricity and Water Authority, Mohammed bin Rashid Al Maktoum Solar Park: Phase IV Operational Report (DEWA 2023).

57 M Nikbakht, P Hajiani and A Ghorbanpur, 'Assessment of the Total-Factor Energy Efficiency and Environmental Performance of Persian Gulf Countries: A Two-Stage Analytical Approach' (2023) 30 Environmental Science and Pollution Research 10560.

58 Saudi Building Code National Committee, Saudi Energy Conservation Code: SBC 601-CR-18 (Saudi Standards, Metrology and Quality Organization 2018).

59 SA Rehman Khan and others, 'Energy Efficiency, Carbon Neutrality and Technological Innovation: A Strategic Move Towards Green Economy' (2023) 36 Economic Research-Ekonomska Istraživanja.

60 M Al-Samarai and others, 'Climate change, renewable energy, and Gulf Cooperation Council stock market dynamics:

3.1.6. *Oman*

Lacking mandatory standards, Oman's voluntary approach and Energy Master Plan 2040 (30% renewable by 2030) show slow progress due to unenforced protocols.⁶¹

3.2. Case Studies of Successful Energy Efficiency Implementations

3.2.1. *UAE - Dubai Sustainable City*

Launched in 2015, Dubai Sustainable City exemplifies the GCC's push to align urban development with green architecture, adhering to the emirate's Green Building Regulations. As a flagship model, it balances ecological goals with regulatory ambitions, proving the value of performance-based tools. Key achievements include a 50% reduction in peak cooling loads, achieved through passive strategies like optimized building orientation, extended solar shading, and super-insulative materials.

3.2.2. *UAE - Mohammed bin Rashid Al Maktoum Solar Park*

Beneath the aegis of Dubai's Clean Energy Strategy 2050, the Mohammed bin Rashid Al Maktoum Solar Park stands poised to emerge as the largest contiguous solar facility on a single footprint, envisaging an aggregate capacity of 5GW by 2030. Its execution is emblematic of the UAE's overarching trajectories of energy diversification and environmental stewardship, and the initiative has the following salient features:

_ Phase IV features a 950MW integrated concentrated solar power and photovoltaic system on one site, enhanced by a 15-hour thermal storage, making it a leading renewable energy hub in the UAE.⁶²

_ The feasibility study projects an annual CO₂ reduction of 6.5 million tons, aligning with the UAE's Climate Action Indicators and Nationally Determined Contributions.

3.2.3. *Saudi Arabia - King Salman Park*

Within the framework of Saudi Arabia's urban transformation agenda, the King Salman Park undertaking aspires to establish the world's preeminent urban green space. Beyond landscaping, the initiative foregrounds ecologically centered design, epitomized by the following components:

- A decentralized solar power matrix will energize lighting, healing gardens, and sport complexes, thereby supporting the objectives articulated in the Saudi Vision 2030 strategy pertaining to renewable energy integration.
- A suite of Internet-of-Things instruments will continuously evaluate ambient conditions and

A quantile vector autoregression and wavelet quantile framework' (2025) 11 Energy Reports 101035.

61 M Al-Yabhouni and others, 'The GCC's path to a sustainable future: Navigating the barriers to the adoption of energy efficiency measures in the built environment' (2024) 22 Energy Conversion and Management: X 100636.

62 K Obaideen and others, 'On the contribution of solar energy to sustainable development goals: Case study on Mohammed bin Rashid Al Maktoum Solar Park' (2021) 12 International Journal of Thermofluids 100123.

fluorescence levels to modulate energy outputs. Led by adaptive lighting and programmable thermal zoning, technologies curtail power consumption significantly.⁶³

3.2.4. Qatar - Qatar University Sustainability Project

Serving as a living laboratory, Qatar University's Sustainability Project elucidates the coupling of pedagogical objectives and energy conservation. Initiated in 2014, the initiative consolidates complementary interventions, including:

_ A group of high-performance buildings at Qatar University achieves a 30% cooling load reduction using reflective roofing, shading fins, and an HVAC system with predictive control based on occupancy and thermal cycles.

_ A campus-wide solar photovoltaic array powers a significant portion of the university's electricity, supporting Qatar's 2030 sustainability goals.⁶⁴

3.2.5. Bahrain - Bahrain World Trade Center (BWTC)

The Bahrain World Trade Center (BWTC) exemplifies a vertically integrated approach to energy-efficient architecture within the Gulf, ranking among the tallest structures in the nation and featuring a host of advanced sustainability technologies. Core components of the design include:

_ Three aerodynamically profiled wind turbines positioned between the twin tower masses collectively supply as much as 15% of the facility's operational electricity, thereby modulating the energy balance of the glass-and-steel envelope.

_ A supplemental constellation of photovoltaic panels, in concert with high-integrity fittings and controls, further minimizes dependence on external supply and accentuates the building's ecological profile.

3.3 Original Contribution and Empirical Insights

This analysis enhances understanding of GCC energy efficiency by providing new empirical evidence through a comparative policy framework, focusing on the UAE, Saudi Arabia, Qatar, and Bahrain. It uses GCC Statistical Centre data and case studies like Dubai's Sustainable City to evaluate energy savings, retrofitting, and digital grid adoption.

The study emphasizes technological diffusion as key to efficiency gains, noting that smart grids in Masdar and Sustainable City optimize consumption, though broader adoption lags due to missing digital infrastructure in older buildings. It also identifies institutional fragmentation and market barriers, including the split-incentive issue where landlords bear costs but tenants reap savings.⁶⁵ ⁶⁶

63 Kingdom of Saudi Arabia, Energy Sector Transformation (Saudi Vision 2030, 2021).

64 Khan (n 4) 17.

65 IMF, Fiscal reforms and energy subsidies in the GCC (International Monetary Fund 2015).

66 UNESCWA, Case Study: Energy Efficiency in Buildings – Kuwait (United Nations Economic and Social Commission for Western Asia 2019).

Table [5] shows applicable results, and field data upon key performance metrics to show the real-world differences, and effects of energy efficiency efforts across the GCC.

Table 5: Applied Results and Case Data for Field Evidence

Country	Case/Metric	Indicator/Result
Bahrain	Building stock compliance (2023)	<9% of buildings meet current standards
Qatar	Gov. buildings energy reduction (2023)	23% reduction with GSAS compliance
Qatar	Private sector GSAS uptake	41% compliance rate
UAE	Dubai Sustainable City cooling savings	50% reduction via design, 60% via rooftop solar
UAE	Masdar City district cooling savings	70% less energy than traditional AC
GCC avg.	Digital building records	<35% of buildings with digitized energy records
GCC (all)	Tech retrofit adoption	Slow, with payback of 11–70 years unless tariff reform

3.4. Persistent Challenges

Despite progress in GCC energy efficiency, significant challenges remain. The primary hurdle is persistent energy subsidies, which weaken pricing signals and discourage adoption of efficient technologies by consumers and developers.⁶⁷ Institutional fragmentation, marked by poor inter-agency collaboration and conflicting regulations across ministries, also hinders cohesive policy execution, though the UAE and Saudi Arabia have advanced energy codes despite enforcement weaknesses in other states. Overall, gains are limited by these interconnected barriers, requiring subsidy reform, better data, institutional integration, and flexible design standards to balance economic and environmental goals.⁶⁸

Table 6: Key Barriers to Retrofitting Pre-2010 GCC Building Stock

Challenge	Impact Example	Source
Outdated infrastructure	78% of Kuwaiti buildings lack wiring for smart HVAC controls	UNESCWA ⁶⁹ ; Lee Company ⁷⁰
High upfront costs	Window replacement costs \$120–200/m ² in Saudi Arabia	KAPSARC ⁷¹ ; IW Glass ⁷²
Occupant resistance	42% of UAE building occupants refuse retrofits due to renovation disruptions	Meziani & AlRifai ⁷³ ; J-Stage ⁷⁴

67 KAPSARC (n 28).

68 Lee Company, 'Retrofitting Challenges in the Gulf Region' (2024).

69 UNESCWA (n 66).

70 Lee Company (n 68).

71 Op. cit.

72 IW Glass, 'The price of a meter of glass for facades in Riyadh and the factors affecting it' (2024) <https://iwglass.net/en/the-price-of-a-meter-of-glass-for-facades-in-riyadh/> accessed 27 April 2025.

73 R Meziani and N AlRifai, 'Retrofitting Scenario of Residential Building Envelopes in Abu Dhabi' (2023) 13 International Review for Spatial Planning and Sustainable Development 6.

74 J-Stage, 'Retrofitting strategies in Abu Dhabi' (Japan Science and Technology Agency 2025).

Table 7: Comparative Overview of Energy Efficiency Policy Effectiveness in the GCC

Country	Main Policy/Program	Key Success	Main Challenge
UAE	Green Building Code, Estidama	Masdar City, Solar Park	Retrofitting, data gaps
Saudi Arabia	SEEP, SBC 601	Appliance standards, awareness	Rapid demand growth
Qatar	GSAS, Tarsheed	Public sector savings	Private sector enforcement
Bahrain	NEEAP	Early target achievement	Low compliance with the old stock
Kuwait	R-6 Code	Peak demand reduction	Enforcement, retrofitting
Oman	Voluntary guidelines	Pilot projects	No mandatory framework

4. Recommendations for Enhancing Energy Efficiency and Conservation in the GCC

The integration of advanced technologies alongside the enforcement of energy-efficient building regulations, standards, and policies that unify the varying approaches among GCC countries positions the GCC to achieve considerable progress in sustainable construction and infrastructure development.⁷⁵

4.1. Reforming Energy Subsidies to Encourage Conservation

One of the most significant barriers to energy efficiency in the GCC is the widespread energy subsidy system. While subsidies have played a crucial role in economic development and social stability, they have also contributed to inefficient energy consumption. Phasing out or restructuring subsidies can create financial incentives for consumers and industries to adopt energy-efficient practices.⁷⁶

Some GCC countries have already begun subsidy reforms. Saudi Arabia, for instance, implemented gradual energy price increases under its Vision 2030 strategy. However, these reforms must be accompanied by targeted social safety nets to mitigate the impact on low-income households. Additionally, adopting a tiered pricing system, where higher consumption levels are charged at progressively higher rates, could help balance affordability with conservation efforts.

4.2. Strengthening Institutional Frameworks for Energy Governance

A major challenge facing energy efficiency policies in the GCC is the fragmentation of responsibilities among multiple government entities. Establishing dedicated national energy efficiency agencies or councils could enhance coordination and policy implementation. These institutions should be tasked with setting clear energy efficiency targets, enforcing regulations, and monitoring progress.⁷⁷

For example, the Saudi Energy Efficiency Centre (SEEC) has played a key role in coordinating

⁷⁵ Khan (n 4) 4.

⁷⁶ L El-Katiri and B Fattouh, 'A Brief Political Economy of Energy Subsidies in the Middle East and North Africa' (Oxford Institute for Energy Studies 2017).

⁷⁷ HA Kazem and MT Chaichan, 'The impact of climate change on energy consumption in the GCC countries' (2017) 78 Renewable and Sustainable Energy Reviews 456.

energy efficiency initiatives in the Kingdom. Expanding such models across other GCC countries could help streamline efforts and improve regulatory enforcement.

4.3. Enhancing Energy Efficiency Standards and Compliance

While many GCC countries have developed energy efficiency regulations, enforcement remains inconsistent. Strengthening compliance mechanisms through building inspections, appliance testing, and market surveillance can ensure adherence to energy efficiency standards.

For instance, Dubai's Green Building Regulations have been successful in improving energy efficiency in new developments. However, expanding these regulations to mandate retrofitting older buildings could yield even greater energy savings.

4.4. Expanding Renewable Energy Integration

Renewable energy plays a crucial role in reducing reliance on fossil fuels and improving overall energy sustainability. While the GCC has made strides in deploying solar and wind energy, further investments in grid integration and storage technologies are needed to enhance the reliability of renewable energy sources.⁷⁸

A coordinated regional approach to renewable energy deployment could help optimize resource allocation. For example, establishing a GCC-wide electricity grid that allows cross-border energy trading could enable countries to benefit from each other's renewable energy potential, thereby reducing overall energy consumption.

4.5. Promoting Public Awareness and Behavioral Change

Public engagement is essential for the success of energy efficiency initiatives. Many consumers in the GCC are unaware of the benefits of energy conservation, given the historical reliance on cheap and abundant energy. Awareness campaigns, educational programs, and incentives for energy-efficient behaviors should be prioritized.

UAE's "Estidama" initiative promotes sustainability practices in Abu Dhabi and serves as a model for integrating public awareness with regulatory frameworks. Expanding similar programs across the region could drive behavioral change and encourage citizens to take an active role in energy conservation.

4.6. Improving Data Collection and Transparency

Accurate and transparent data on energy consumption is critical for effective policymaking. GCC countries should invest in smart metering, real-time energy monitoring, and open data platforms that allow policymakers and researchers to assess energy trends and identify areas for improvement.

⁷⁸ M Krarti and K Dubey, 'Energy Efficiency Strategies for Sustainable Development in the Gulf Cooperation Council' (2018) 91 Renewable and Sustainable Energy Reviews 1143.

The UAE’s Smart Dubai initiative, which incorporates digital technologies to optimize resource use, offers valuable insights into how data-driven strategies can enhance energy efficiency. A regional collaboration on energy data-sharing could further bolster evidence-based policy decisions.⁷⁹

4.7. Innovative Financing Mechanisms

To address energy efficiency barriers in the GCC, tailored financing is crucial. Scaling ESCOs regionally, like Saudi Arabia’s SEEC, and a GCC-wide ESCO Fund with green sukuk offering 80% credit guarantees could reduce investment risks. Kuwait’s R-6 Code cut commercial demand by 18%, but residential retrofits need mixed funding. The “Negabarrel” initiative suggests using 1% of oil revenues, combined with the UAE’s \$10.7B green bonds (2023), to raise \$61B for retrofits by 2030. Bahrain’s EWA inspections show public-private partnerships boost efficiency and lower risks.⁸⁰

Table 8: Proposed Regional Cooperation Framework

Component	Action	Timeline
Grid Integration	Expand GCC Interconnection Authority (GCCIA) capacity	2024–2026
Data Sharing	Centralize smart meter data via the UAE’s Smart Dubai model	2025–2027
Policy Harmonization	Adopt Qatar’s GSAS as the baseline for all new buildings	2026–2028

4.8. Ensuring Effective Outcomes through Targeted Interventions

The policy-practice gaps, the requirement of data collection, and the retrofitting of old buildings should be recommended in order to increase energy efficiency in the GCC. Policy gaps can be closed by strong implementation, auditing, digital permitting, and frequent compliance statistics.⁸¹ Smart meters and central databases can enhance reliable data collection, which is measured by digitized records and real-time reporting for policy evaluation. Retrofitting will necessitate scaling up of public-private partnerships, funding, and local guidelines, which will be followed by retrofitted structures and energy use. Reduction in subsidies, gradual increase in tariffs, support systems, and outreach may become the driving factor of behavior change, but can be monitored through surveys. GCC approach will be brought together through regional cooperation and standardization, based on standards such as GSAS of Qatar or Estidama Pearl of Abu Dhabi.⁸²

Conclusion

The Gulf Cooperation Council (GCC) states now occupy a critical juncture in their energy transition. Despite significant progress in adopting energy efficiency policies, substantial challenges persist.

79 Alawadh and Al Zahmi (n 54).

80 Op. cit.

81 M Al-Rifai and others, ‘A review of building envelope retrofitting methods for improving energy efficiency, aesthetic, and indoor environmental quality’ (2025) 16 Energy Nexus 100407.

82 RA Al-Masri and MS Alshitawi, ‘Electricity consumption indicators and energy efficiency in residential buildings in GCC countries: Extensive review’ (2022) 255 Energy and Buildings 111664.

Deeply entrenched energy subsidies, weak enforcement mechanisms, and fragmented institutional structures continue to impede further progress.⁸³

This analysis contends that a more coordinated and holistic regulatory framework is essential to overcome these obstacles. Specifically, reforming subsidy structures, strengthening institutional capacity, enhancing regulatory compliance, expanding renewable energy initiatives, promoting public awareness, and improving data transparency are critical steps toward realizing significant energy savings while concurrently supporting economic diversification and environmental sustainability.⁸⁴ However, any energy conservation policies must be crafted in a manner that avoids hindering economic growth.⁸⁵

Moreover, regional collaboration among GCC states could substantially amplify these efforts. A unified energy efficiency framework, complemented by the exchange of best practices and joint renewable energy projects, may not only bolster individual national initiatives but also position the GCC as a global leader in sustainable energy management.⁸⁶ By prioritizing long-term energy efficiency strategies, the GCC countries can lay the groundwork for a more resilient and sustainable energy future.

83 See, for example, M Al-Saidi and H Al-Falih, 'Energy Policy and Reform in the Gulf: Progress and Persistent Challenges' (2023) 28 *Journal of Energy Studies* 455.

84 SASO, ESMA and G-Mark (n 47).

85 AlKhars (n 6) 3.

86 Regional case studies highlight the benefits of unified approaches in advancing sustainable energy management.

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