Going Green:
Rooftop solar potential in the GCC

2025

White paper series

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EXECUTIVE SUMMARY

The UAE and Saudi Arabia lead the region in terms of their development pipelines, with numerous real estate projects expected to be completed by 2040 to accommodate rapidly growing populations. This extraordinary growth necessarily prompts discussions about the energy needs of the glittering cities across the GCC, particularly in the context of a warming world, where the built environment accounts for 39% of global carbon emissions.

Governments around the region are at the forefront of addressing this very issue, with targets in place to help reduce both the economic and energy reliance on hydrocarbons. In Saudi Arabia, for instance, the government has set a net-zero target for 2060, with an interim target of reducing carbon emissions by 238 million tonnes by the end of the decade.

In the UAE, the authorities hope to achieve net-zero emissions by 2050. Notably, Dubai has set a goal of generating 75% of its energy needs from solar power by 2075, with the remaining 25% from other clean energy sources. To this end, the emirate continues to expand what is already the world's largest single-site solar power plant: the Mohammed Bin Rashid Solar Park.

Given the abundance of sunny days in the Gulf, our geospatial team, in collaboration with University of Leeds and University of Bristol, has investigated the viability of using rooftop space in cities around Saudi Arabia and the UAE to generate solar power.

Our whitepaper evaluates the technical and economic feasibility of rooftop solar power generation in the GCC, focusing on Abu Dhabi and Riyadh as representative city-scale case studies. Using geospatial modelling, cost benchmarks and national policy analysis, it identifies where distributed solar generation can become a commercially viable component of national energy strategies.

KEY FINDINGS INCLUDE

- **Scale drives efficiency.** Larger rooftops achieve significantly lower generation costs due to economies of scale. In Abu Dhabi, rooftop systems above 10,000 sqm deliver a Levelised Cost of Energy (LCOE) (a measure of the average net present cost of electricity generation over an asset's lifetime) as low as 0.08 AED/kWh, which is comparable to utility-scale solar parks.
- **Commercial readiness.** In Riyadh, rooftop systems on industrial and logistics buildings could achieve payback within 7–11 years, based on data from the national Shamsi Solar Calculator.
- **Policy leadership.** Both the Saudi and UAE governments are building on world-leading utility-scale success to enable distributed solar frameworks that complement Vision 2030 (Saudi Arabia) and Energy Strategy 2050 (UAE).

The findings demonstrate that distributed rooftop solar is no longer a peripheral technology but is capable of becoming a central element of regional energy planning – delivering long-term energy cost stability, grid resilience and investment-grade carbon reduction.

FROM UTILITY-SCALE SUCCESS TO DISTRIBUTED OPPORTUNITY

Over the past decade, Saudi Arabia and the UAE have established themselves among the world's most cost-efficient solar producers. Projects such as Noor Abu Dhabi, the Mohammed Bin Rashid Al Maktoum Solar Park, Sakaka, Sudair and Al Shuaibah have achieved record-low tariffs below AED 0.06/kWh, demonstrating the competitiveness of solar power in desert climates. For context, recent evidence from California shows residential rooftop solar costs of around AED 0.26/kWh and 0.19 AED/kWh for utility-scale systems.

The next stage of growth will extend this success from remote solar parks to urban and industrial environments, where energy demand is concentrated. Rooftop and on-site solar systems can supply electricity directly to end users, reducing grid losses, easing peak load pressures and supporting energy independence for large consumers.

Photovoltaic (PV) systems are typically deployed as either centralised, utility-scale plants or decentralised rooftop installations.

Utility-scale systems benefit from optimised siting, economies of scale, and higher energy output, while rooftop systems capitalise on existing infrastructure with lower land and environmental impact.

Dubai's vast Mohammed Bin Rashid Solar Park

UNDERSTANDING ABU DHABI'S SOLAR ROOFTOP POTENTIAL

UAE renewable energy context

The UAE has committed to becoming a global clean energy leader, targeting 50% of electricity generation from clean sources by 2050 and a 70% reduction in carbon emissions as part of the UAE Energy Strategy 2050. Major progress to date has come from utility-scale solar projects; however, rooftop solar remains significantly underexploited, contributing less than 1% of installed solar capacity.

Unlike utility-scale solar, rooftop PV does not require new land, reduces transmission loads, and delivers clean energy directly at demand centres, making it not only environmentally strategic but economically compelling.

Measuring rooftop potential in Abu Dhabi

To assess rooftop solar viability in the UAE, we combined geospatial and economic analysis.

Installation and performance estimates for the UAE capital were derived from the Shams Dubai (DEWA) Solar Calculator. While originally designed for Dubai, it provides the most detailed and regionally relevant dataset available. We have therefore used it as a proxy for Abu Dhabi, given the similar climatic and market conditions across the UAE. Minor cost variations may exist due to differences in labour costs, equipment pricing and permitting frameworks, but these do not materially impact our regional comparisons for rooftop solar analysis.

Shams provided CAPEX, annual OPEX, annual generation and annual avoided CO_2 for a known rooftop area. This provided a size-diverse training set ranging from small (<100 m²) to very large (>10,000 m²) roofs.

Geospatial analysis was used to calculate the total area of each sample's usable area. A rooftop utilisation factor of 47.5% was applied, which reflects commonly used industry assumptions for urban rooftop PV potential and sits within the typical 40–60% range observed across different building types.

This allowed us to compute two decision metrics for every size of roof:

1) LCOE (AED/kWh): average cost of electricity to assess the long-term economic performance of rooftop PV systems.

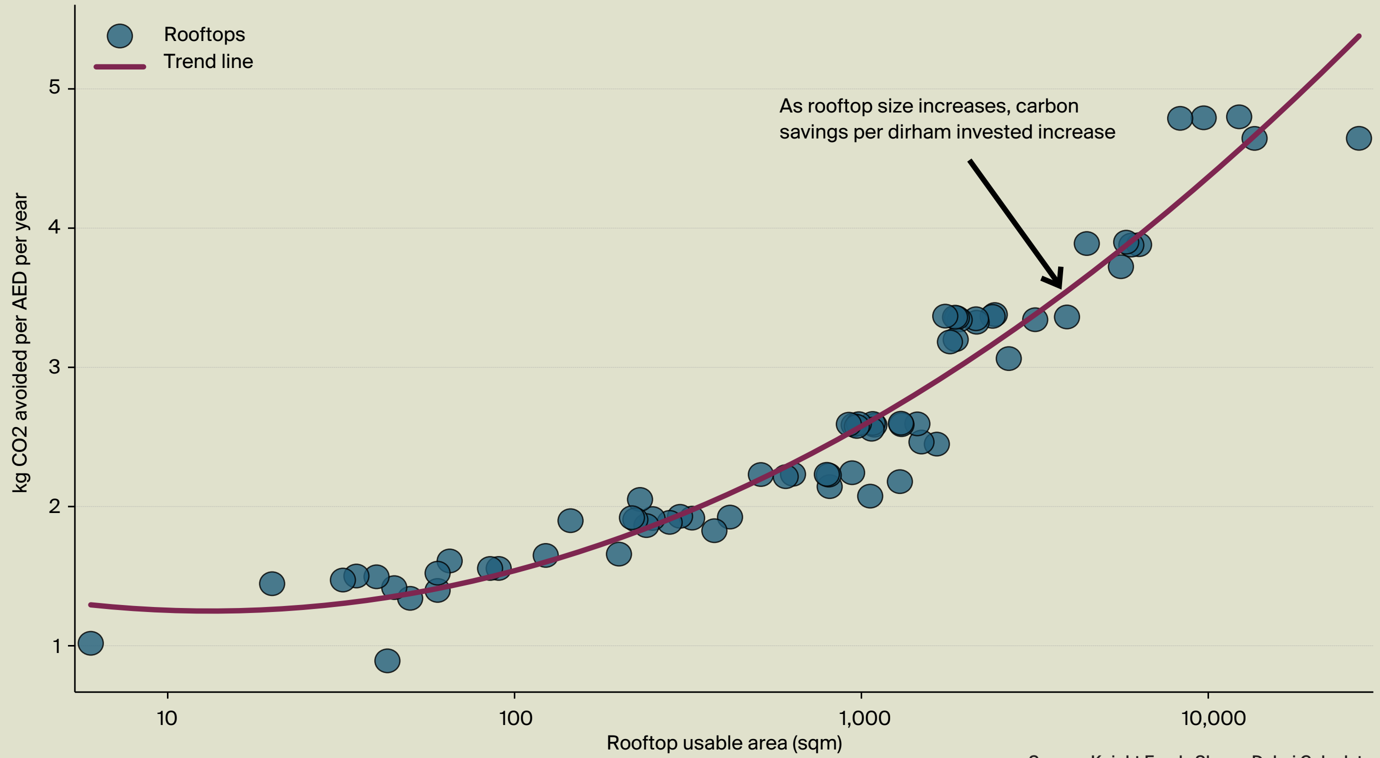
2) Carbon efficiency (kilograms of CO_2 avoided per AED, per year): annual avoided carbon emissions per AED spent for each rooftop sample. This metric captures how efficiently financial inputs translate into carbon savings, enabling fair comparison across PV systems of different sizes and costs.

These two metrics allow a like-for-like comparison across roof sizes (cost and climate return per dirham).

For both metrics, a 25-year projection period was used. This duration reflects the standard operational lifespan of PV installations and is widely adopted in international renewable energy assessments.

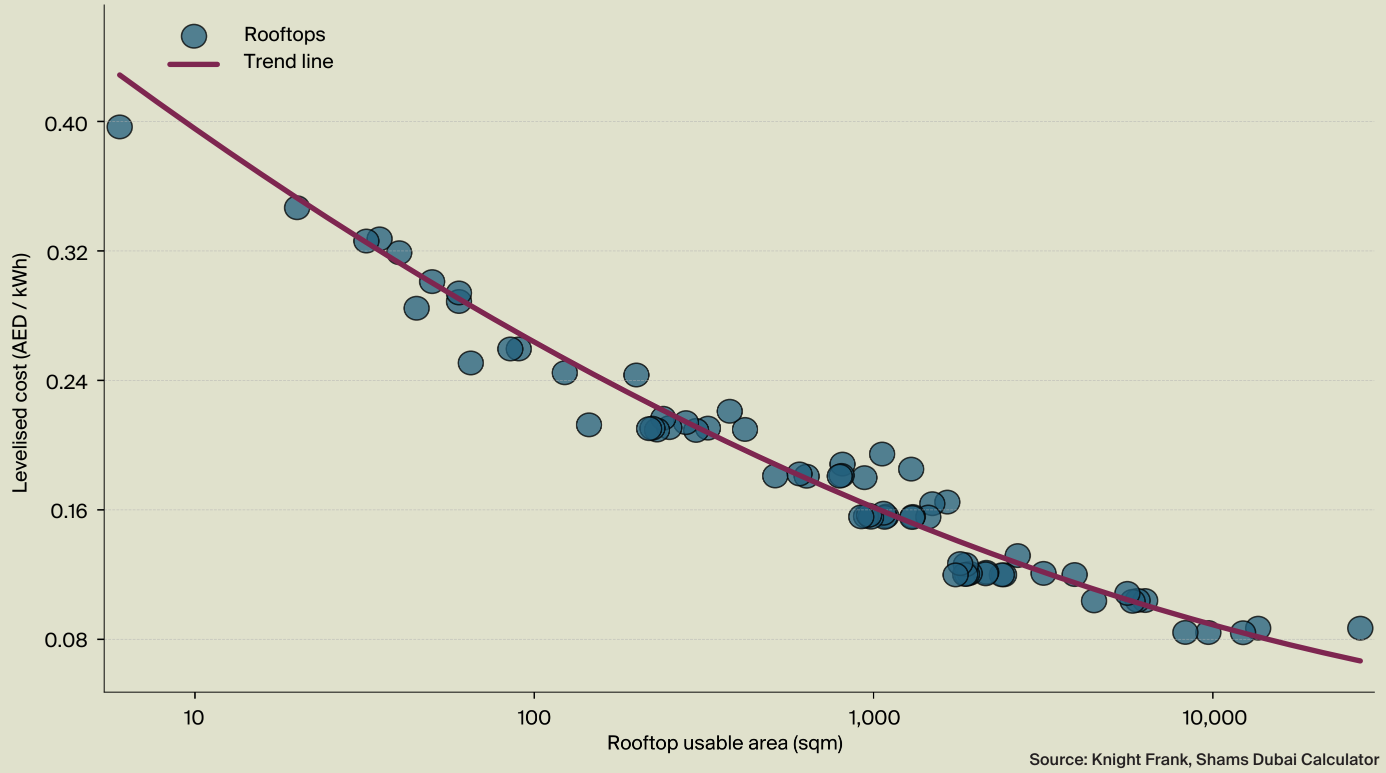
Abu Dhabi skyline

Environmental return on investment: larger rooftops help avoid more carbon emissions per dirham



Source: Knight Frank, Shams Dubai Calculator

Effect of rooftop usable area on on PV installation cost



Source: Knight Frank, Shams Dubai Calculator

UNDERSTANDING ABU DHABI'S SOLAR ROOFTOP POTENTIAL

Results

The analysis reveals that system size is a strong driver of rooftop solar cost-efficiency. As rooftop area increases, both LCOE performance and carbon savings per dirham improve. Large rooftops (>10,000 sqm) deliver the strongest performance, achieving nearly 5 kg of CO_2 avoided annually for every dirham invested – creating a clear investment driver.

Large-scale rooftop systems also deliver utility-scale cost competitiveness without the land and complexities of developing and maintaining solar parks in desert locations. In effect, these are investment-grade solar assets ready for deployment today.

Comparison with utility-scale solar parks

To put our findings in context, our study uses utility-scale benchmark data from the 6th phase of the Mohammed bin Rashid Al Maktoum Solar Park in Dubai. The project spans 20 sq km, generates 1,800 MW, and delivers an LCOE of 5.96 fils/kWh – among the lowest worldwide.

We grouped rooftops into four main size categories based on usable area (sqm) and calculated average LCOE.

Our results confirm a strong size-to-cost relationship: smaller rooftops (≤100 sqm) remain costly at over 30 fils/kWh, while larger rooftops (>1,100 sqm) achieve around 13 fils/kWh – a price reduction of nearly 60%.

The largest rooftop systems in our sample (exceeding 10,000 sqm) achieved costs as low as 8 fils/kWh. This is only 2 fils above utility-scale generation costs of 5.9 fils/AED achieved by the sixth phase of the Mohammed Bin Rashid utility-scale solar park.

Our findings clearly demonstrate that under favourable conditions, large rooftop PV arrays can approach utility-scale cost competitiveness while offering the added advantage of minimising ecological disturbance, and making use of existing buildings and utilities infrastructure.

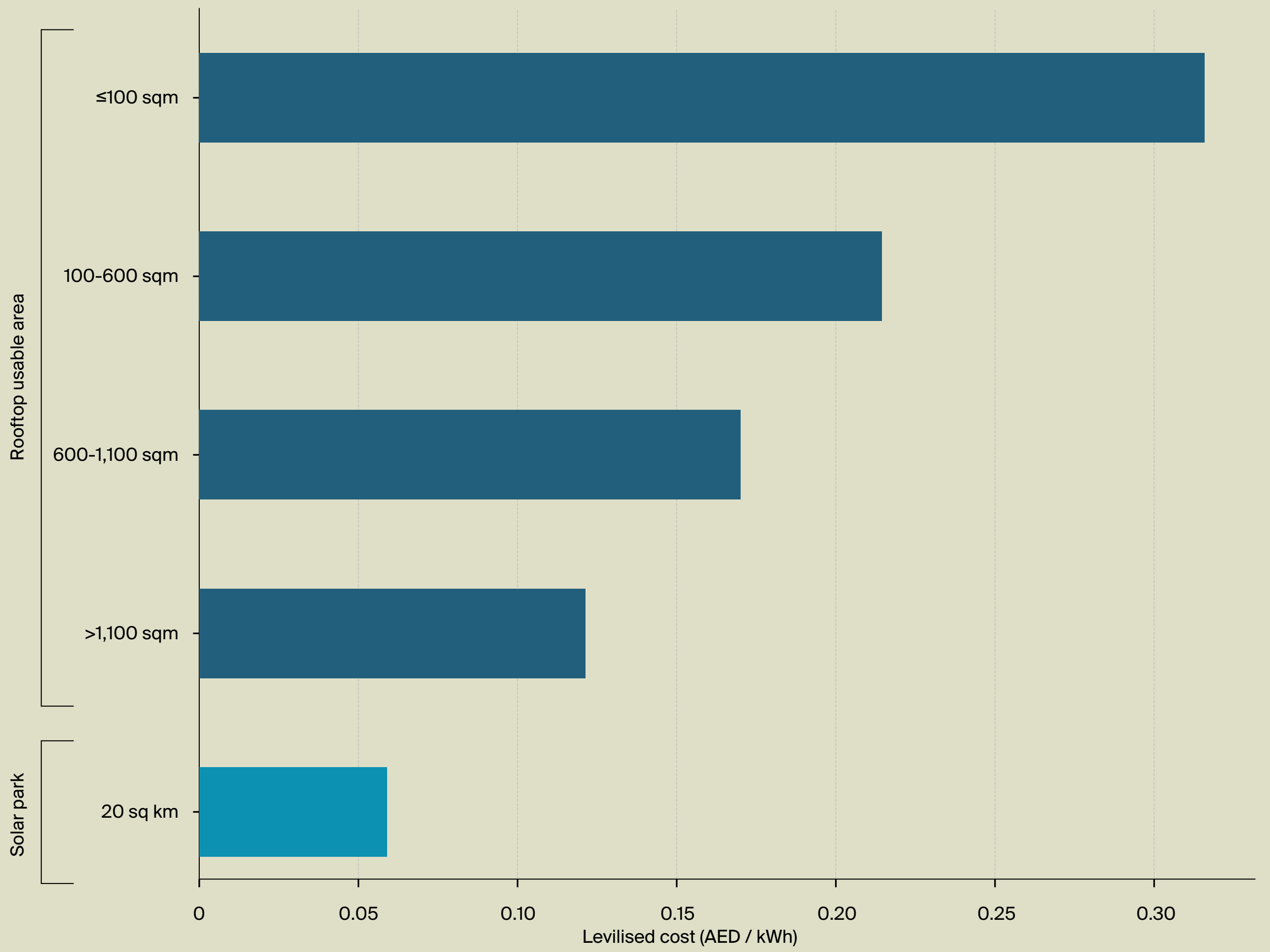
Building inventory

Using a GIS-based rooftop assessment of over 266,000 buildings across the Abu Dhabi Region, a rooftop inventory was constructed to quantify deployable solar capacity. The analysis identified an extraordinary 42.8 sq km of usable rooftop area, equivalent to more than 6,000 football pitches of solar-ready space – offering roughly 55.5% of the land area occupied by the Mohammed bin Rashid Solar Park in Dubai. This is the first comprehensive rooftop solar inventory for the region.

Smaller rooftops, with usable areas of less than 100 sqm and up to 600 sqm (shown in blue), dominate the residential landscape; however, these areas offer limited installation potential. Their LCOE averages 33 and 22 fils/kWh, respectively, and they avoid only about 1kg of CO_2 annually per dirham invested.

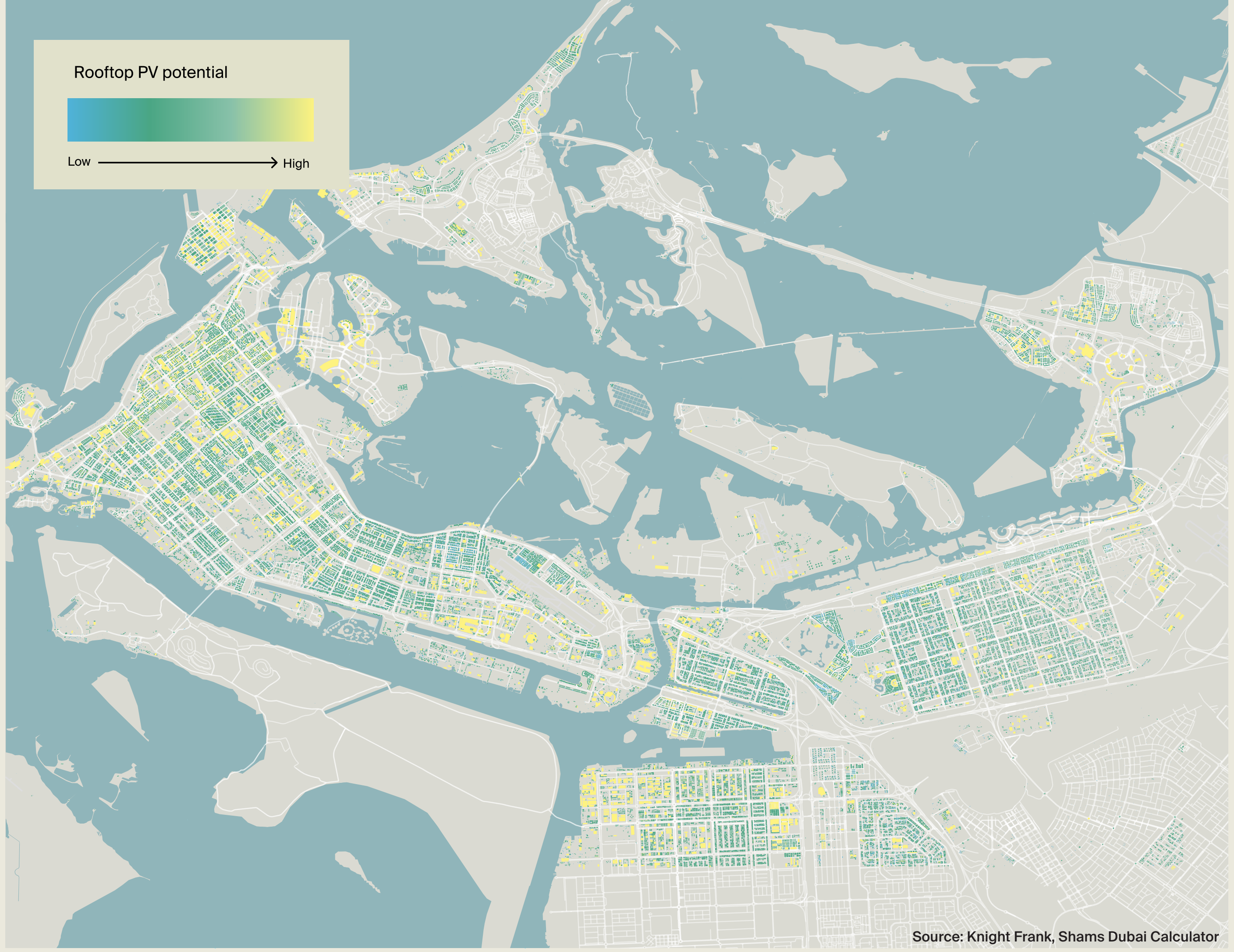
In contrast, medium-sized (>600 sqm) and large-sized rooftops (>1,100 sqm), represented in green and yellow, which are concentrated along major urban corridors, typically in commercial or industrial zones, offer much greater potential. These high-viability sites achieve substantially lower LCOEs - around 18 fils/kWh and 13 fils/kWh – and can avoid up to 5kg of CO_2 annually per dirham invested.

Average cost by rooftop category vs. solar park



Sources: Knight Frank, DEWA

Distribution of rooftop PV suitability across Abu Dhabi



Source: Knight Frank, Shams Dubai Calculator

UNDERSTANDING RIYADH'S SOLAR ROOFTOP POTENTIAL

Saudi Arabia's renewable energy policy context

Saudi Arabia is at the cusp of a transformative energy transition. Under its National Renewable Energy Program (NREP) and Vision 2030, the Kingdom aims to derive 50% of its electricity from renewable sources by 2030 and achieve net-zero emissions by 2060. Meeting this milestone would reduce annual emissions by an estimated 278 million tonnes of CO_2.

With abundant sunlight, rising domestic electricity demand, and falling PV system costs, Saudi Arabia is in one of the strongest positions globally for solar power adoption success.

Market overview and current solar landscape

Saudi Arabia's renewable energy sector is progressing rapidly from pilot initiatives to large-scale commercialisation. The Kingdom's solar infrastructure has expanded significantly over the past five years, supported by government tenders and increasing private-sector participation.

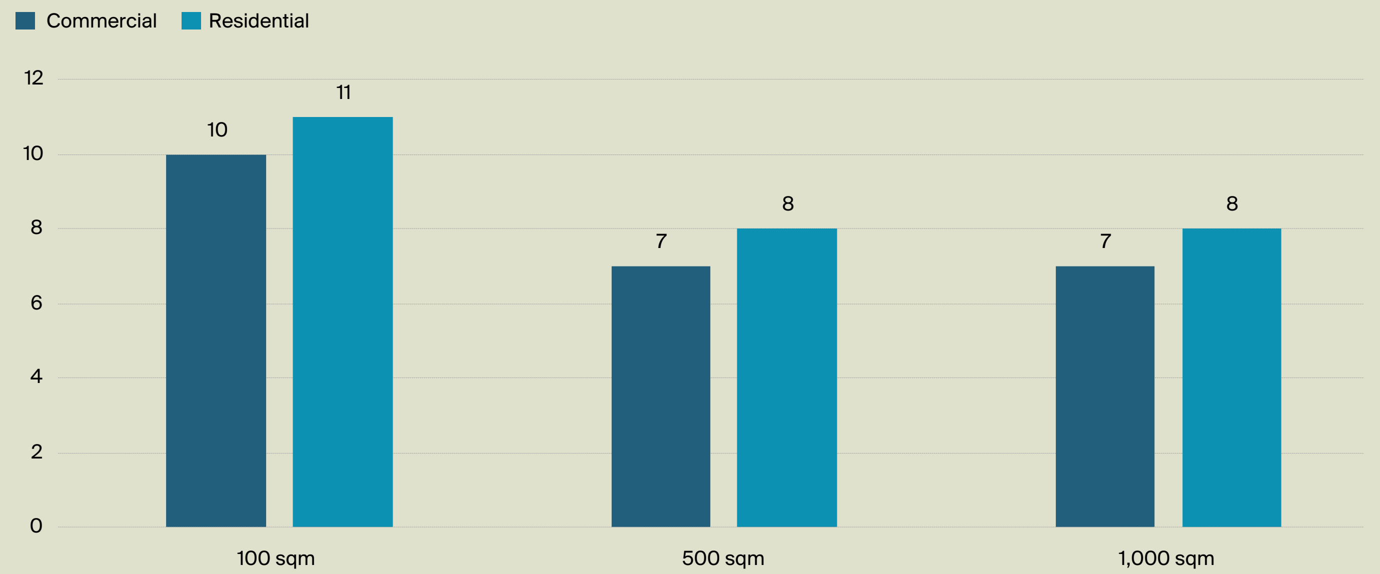
Across the country, utility-scale projects such as Sakaka (300 MW), Sudair (1,500 MW) and Al Shuaibah (2,600 MW) have established benchmarks for cost-competitive solar power, with LCOE ranging between 6-9 halalas/kWh – among the lowest globally. The latest 5.3 GW renewable energy tender launched by the Saudi Power Procurement Company (SPPC) signals a strong government commitment to accelerate deployment under the NREP.

At the smaller end of the market, distributed solar remains at an early, but promising stage. Commercial and industrial installations have begun to emerge in industrial zones, logistics parks and new developments in Riyadh, Dammam and Jeddah. This reflects growing interest in energy diversification and cost efficiency and, of course, a growing call from commercial occupiers for 'greener' assets.

Two main PV configurations dominate solar deployment in Saudi Arabia: fixed mounts and single-axis tracking systems. Fixed mounts are simpler, less capital-intensive, and more common in residential projects, as they maintain panels at a constant tilt optimised for annual irradiation. In contrast, tracking systems have moving parts (motors and actuators) to follow the sun's movement throughout the day. They provide higher efficiency but are rarely adopted in residential projects because they require more frequent servicing than fixed mounts.

Our analysis of Riyadh-based system providers indicates the following typical installation costs: fixed systems average around SAR 2.5 per watt, single-axis tracking systems around SAR 3.2 per watt, and dual-axis trackers approximately SAR 5.8 per watt.

Payback Period for PV systems in Riyadh



Sources: Knight Frank, Shamsi Portal

While tracking technologies enhance performance, fixed-tilt systems remain the most cost-effective and operationally practical option for rooftop and mid-scale commercial installations across the Kingdom.

As part of the broader Vision 2030 framework, tools such as the Shamsi Solar Calculator have been introduced to help property owners assess rooftop potential, estimate system capacity and forecast annual solar generation.

Based on data derived from the Shamsi Solar Calculator, our analysis shows that rooftop solar in Riyadh achieves payback within 7–11 years, depending on system size and user category. Smaller systems (100 sqm) exhibit longer payback periods – around 10 years for commercial and 11 years for residential users – due to higher unit costs and lower output. Larger installations (≥500 sqm) benefit from greater economies of scale, reducing payback to 7 years for commercial and 8 years for residential systems.

System size is the key determinant of feasibility, with larger rooftops offering more attractive financial returns and directly supporting corporate sustainability and energy efficiency targets under Vision 2030.

Riyadh rooftop inventory

Building on the system-level economics outlined above, we created a geospatial rooftop inventory for Riyadh to quantify the city's total deployable solar potential. Our analysis combines building footprint data with solar irradiation and land-use filters to estimate technically usable rooftop surfaces across the Saudi capital's metropolitan area.

A total of approximately 870,000 buildings were assessed across Riyadh, covering a combined rooftop area of 333 sq km. Again, applying the standard industry benchmark for rooftop utilisation of 47.5%, we were able to estimate that 158.2 sq km of rooftop area exists that could be utilised for PV arrays.

Notably, exactly half of Riyadh's buildings have a usable rooftop area below 100 sqm, while their total rooftop area capacity is just 10%. At the same time, large buildings with over 1,000 sqm of usable rooftop area cover more than 26% of the city.

If all the large buildings' rooftops with over 1,000 sqm of usable area were fully utilised by single-axis tracking systems, an annual generation capacity of 17,500 GWh could be technically possible. That equates to 40.7% of Riyadh's annual electricity consumption, based on 2023 data from GASTAT.

Estimated usable rooftop area (sqm)	Share of buildings	Share of Riyadh's built up area
≤100	50%	10%
>100≤500	44%	49%
>500≤1000	4%	15%
>1000	2%	26%

Sources: Knight Frank, Microsoft Building Footprints, OSM

CONCLUDING THOUGHTS

The UAE and Saudi Arabia have both demonstrated global leadership in advancing clean energy through large-scale solar investments. We believe the next stage of this transition could lie in unlocking the distributed energy generation opportunity through solar systems installed on commercial, industrial, and public rooftops. This decentralised solar power generation can strengthen grid resilience, and accelerate progress toward net-zero goals.

Both countries are now positioned to evolve from centralised clean energy leadership to distributed clean energy leadership. By enabling rooftop solar at scale, both Saudi Arabia and the UAE can also create a new class of sustainable infrastructure assets opening new investment channels that directly align with their long-term national visions.

We like questions. If you've got one about our research,
or would like some property advice, we would love to hear from you.

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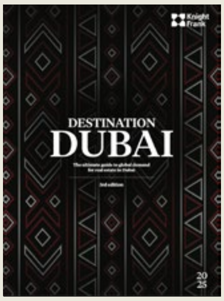

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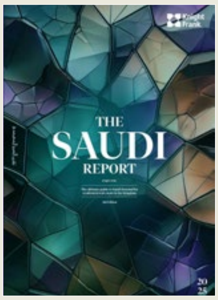

The Saudi Report 2025 - Part One

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