Mapping Solar PV Potential Across Abu Dhabi: A Cost-Effectiveness and Carbon Analysis

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Background and Motivation

Abu Dhabi Region has one of the highest electricity consumption rates globally, yet solar energy contributes only 6.3% to its energy mix—less than 1% from rooftop photovoltaic (PV) systems. As part of its clean energy strategy, the region is promoting broader rooftop solar adoption. This study identifies and maps the most suitable rooftops for PV deployment across the region.

Data and Methods

A GIS-based approach was used to assess how rooftop size affects both carbon reduction potential and the cost per kWh of rooftop solar energy.

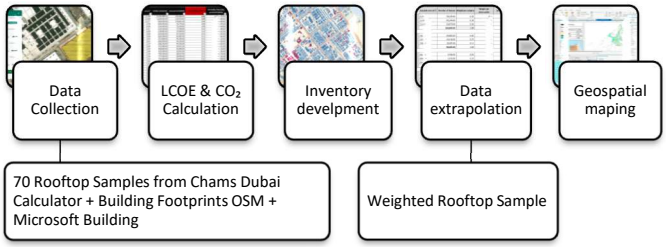

Figure 1. Methodology Workflow

Key Findings

(1) Larger rooftops achieve greater CO_2 reduction potential: up to 5 kg per year for rooftops over 1 hectare.

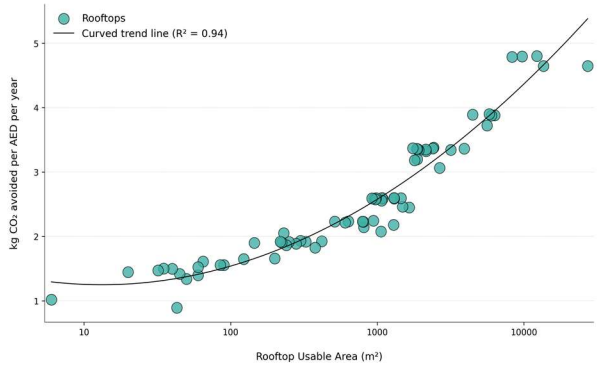

Figure 2. CO_2 Avoidance per AED by Rooftop Size

Reference:
Dubai Electricity and Water Authority (DEWA). 2023. Shams Dubai Calculator. [Online].
GeoJamal. 2024. United Arab Emirates: Direct Download free OSM Shapefiles. [Online].
Microsoft. 2025. Global ML Building Footprints. [Online].

(2) PV deployment costs drop with rooftop size. Small areas (under 100 m²) averaged 0.33 AED/kWh, while large ones (over 1,100 m²) reached 0.12 AED/kWh. These are closest in cost to utility-scale solar, which can reach around 0.06 AED/kWh.

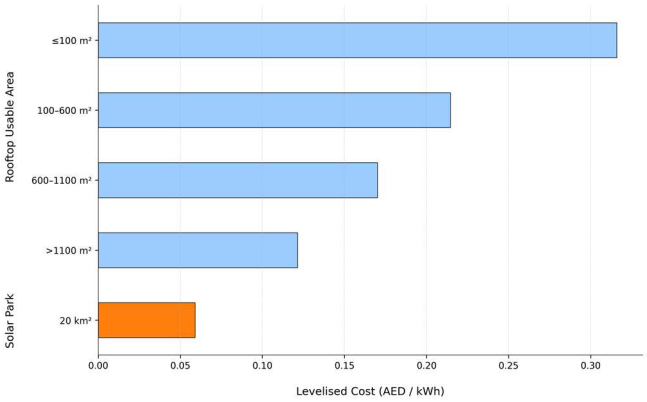

Figure 3. Average Cost by Rooftop Category Vs Solar Park

(3) The study identified 266,495 buildings with 42.8 km² of usable rooftop area. Although only 3% were classified as moderate to high viability, they accounted for 38% of the area, enough to supply 96,112 residents.

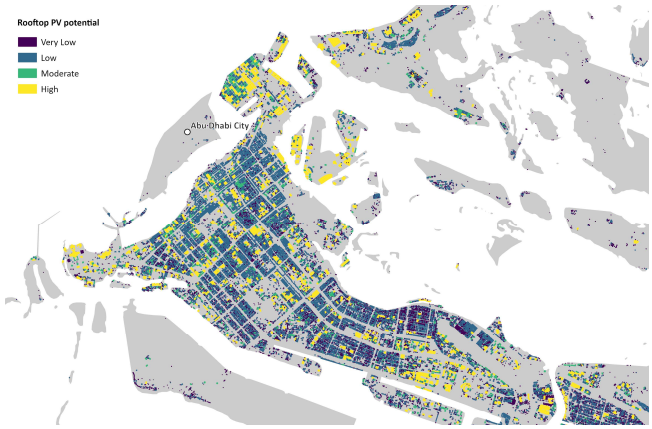

Figure 4. Rooftop Viability for PV Deployment
Link to interactive map: arcg.is/1yGyPD

Value of the research

This study presents the first rooftop PV viability map for the Abu Dhabi Region, offering a decision-support tool for policymakers and investors to target the most cost-effective and carbon-efficient rooftops. The GIS-based approach provides a structured, replicable framework to support decentralised solar planning across different regions.