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Investment in Distributed Solar Generation - A case for Abu Dhabi, UAE

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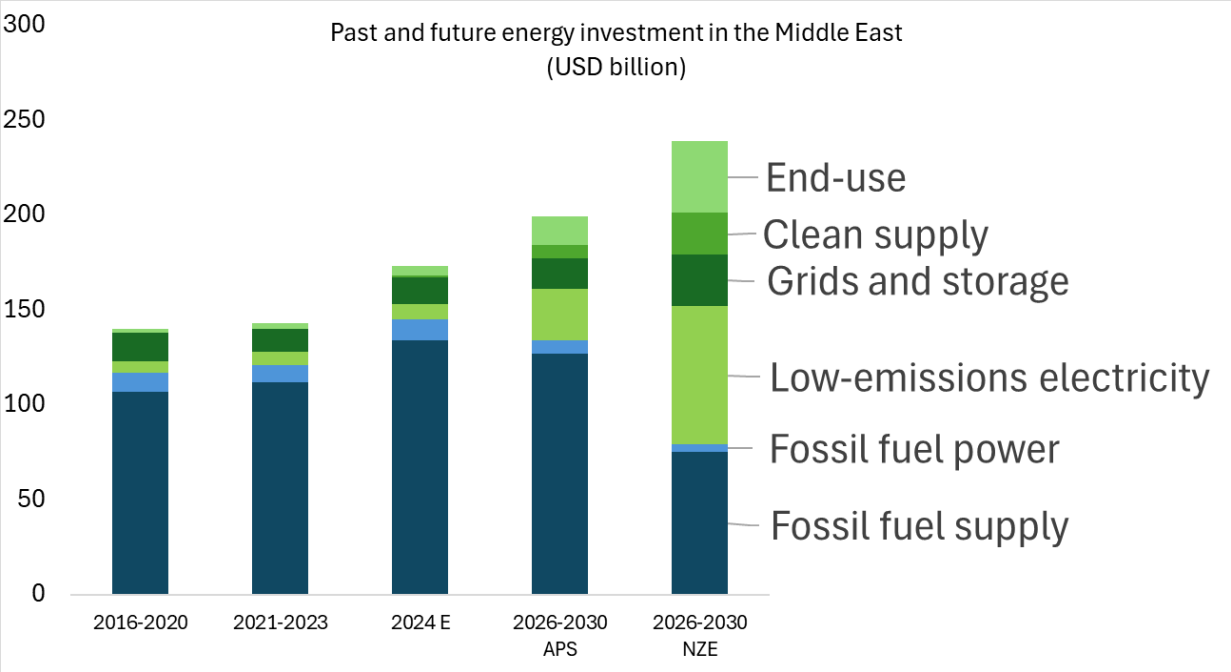
Investment in Distributed solar – A case for Abu Dhabi, UAE

1. Cash for clean and green energy investments?

The middle east, comprising of 12 countries, currently invests only 20 cents into clean energy for every dollar invested in fossil fuels [1]. Under the Announced Pledges scenario (APS), the International Energy Agency (IEA) estimates that in comparison to 2024 levels, the investments in clean energy are expected to double by 2030 (Figure 1). The Net Zero Emissions (NZE) scenario would see an increase of almost 6 times.

Figure 1: IEA forecast of energy investments for Middle east under APS and NZE scenarios [2]



Supporting the global decarbonisation efforts, UAE and Oman have set net zero targets for 2050. Saudi Arabia, Bahrain and Kuwait have announced net-zero commitments for the year

2060. The UAE government has further set an aim to invest over $163 billion by 2050, in clean and renewable energy and supporting technologies [3].

2. Is the electricity subsidy counter-productive?

The governments in the region currently subsidise the use of electricity by providing a 'subsidy' to the energy companies, which allows these companies to keep the 'consumer tariff' well below the 'economic cost', i.e. the total cost of generating, transmitting and distributing each unit of electricity (Figure 2).

Figure 2: Comparison between 'economic' cost and 'tariff' for electricity

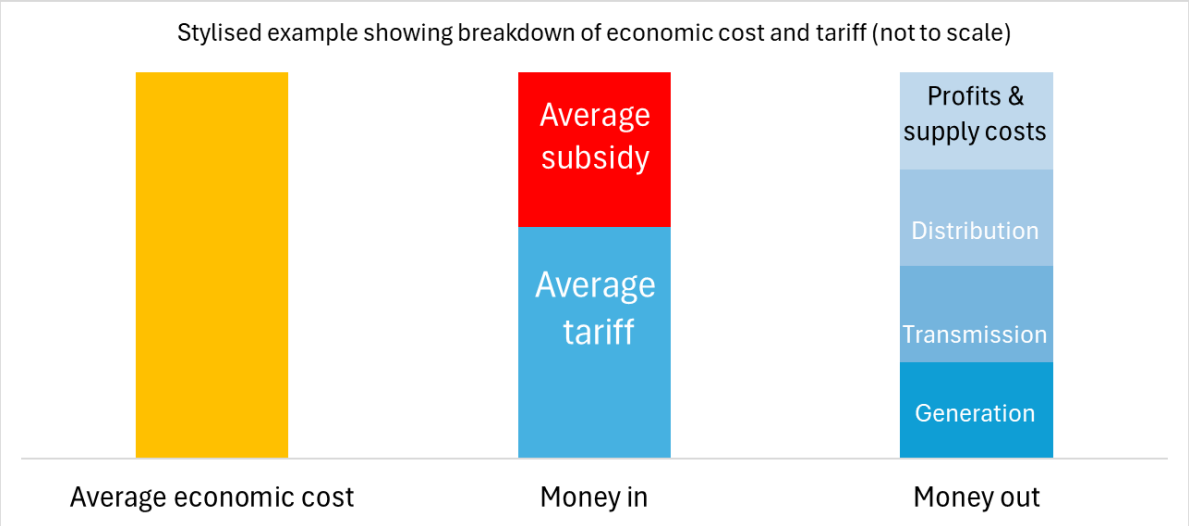
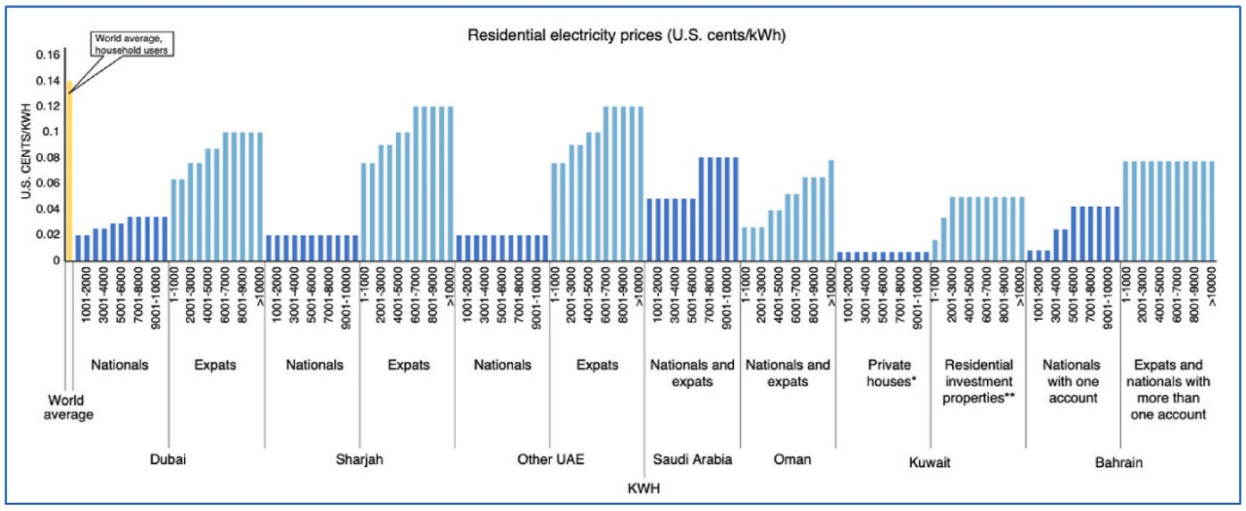


Figure 3: Residential electricity tariff for GCC countries [4]

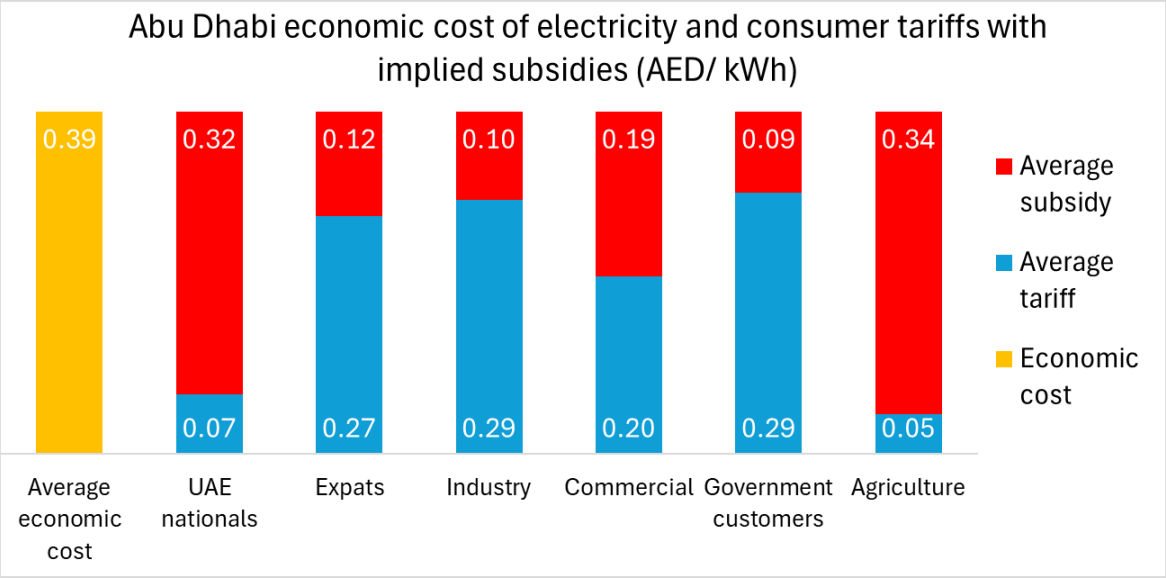


The consumer tariff is also seen to vary between countries' 'national' and 'expat' consumers (Figure 3), which, as we explain below, often leads to alternative sources of electricity, such as distributed solar generation, becoming economically unviable for the nationals.

Thus, the subsidy borne by governments vary, based on the region (e.g. country, emirate) and the group of consumers (e.g. nationals, expat etc). Taking the UAE as an example, we show, in this article, how subsidies impede net zero targets. By paying for everyone's electricity costs, the UAE government displays its generosity, but these subsidies are self-defeating and bad for climate change. A better use of subsidy monies would be to invest directly in energy efficiency or distributed solar – potentially a win-win-win for government-consumers-environment.

To illustrate, we show the subsidy impact in Abu Dhabi. The average '*economic cost*' for electricity lies in the range of 36-41 fills/ kWh, according to our analysis of Abu Dhabi Department of Energy's price control (RC-2) final determinations [6] and TAQA's 2023 financial statements [7]. This '*economic cost*' is much higher than the consumer tariffs from the Abu Dhabi Distribution Company (ADDC) [5], as shown in Figure 4.

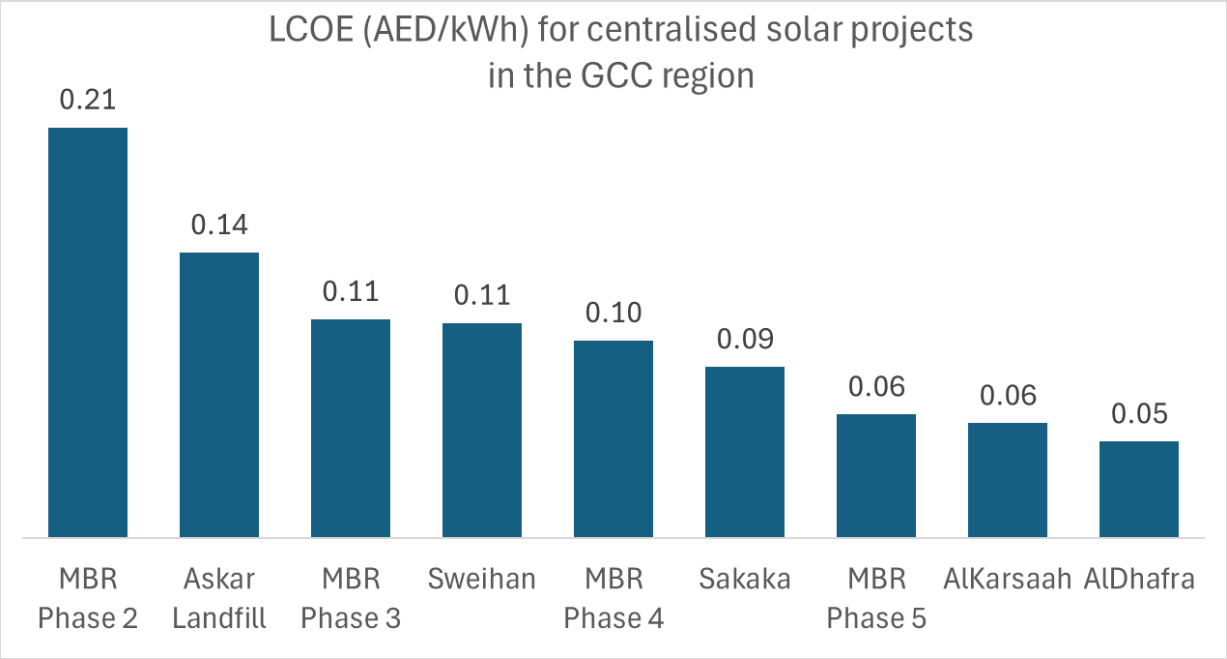
Figure 4: Comparison of calculated economic cost with ADDC tariff and implied subsidy



3. Is bigger necessarily better?

TAQA currently caters for 71% of Abu Dhabi's annual electricity requirements [7]. However, solar energy contributes only a fraction of the overall generation mix. The government has set ambitious targets to decarbonise the energy sector. Solar generation is key to achieving this target, given the significant reduction in costs, as shown in the falling levelised cost of energy (LCOE) for large-scale or 'centralised' solar projects in the GCC region (Figure 5). The Al Dhafra solar project LCOE is only 0.05 AED/ kWh [10].

Figure 5: LCOE for centralised solar projects in the GCC region



Given the low LCOEs for utility-scale solar, there is a big-project-bias. Indeed, bigger may be better. Centralised (utility-scale) solar is cheaper than decentralised (e.g. roof-top) solar on an LCOE basis. However, LCOEs can be misleading as they only reflect the 'generation' costs and not the 'landed' electricity cost that consumers pay, a large element of which is transmission and distribution costs.

In any case, both centralised and decentralised solar can be deployed simultaneously. Indeed, both are needed to achieve green goals. In terms of benefits, decentralised solar (e.g. rooftop) can have the following benefits: 1) diversification; 2) electric-vehicle charging; 3) lower costs for transmission & distribution; 4) faster achievement of green goals; and 5) demand-side management.

Figure 6: Al Dhafra Solar Project, Abu Dhabi, UAE

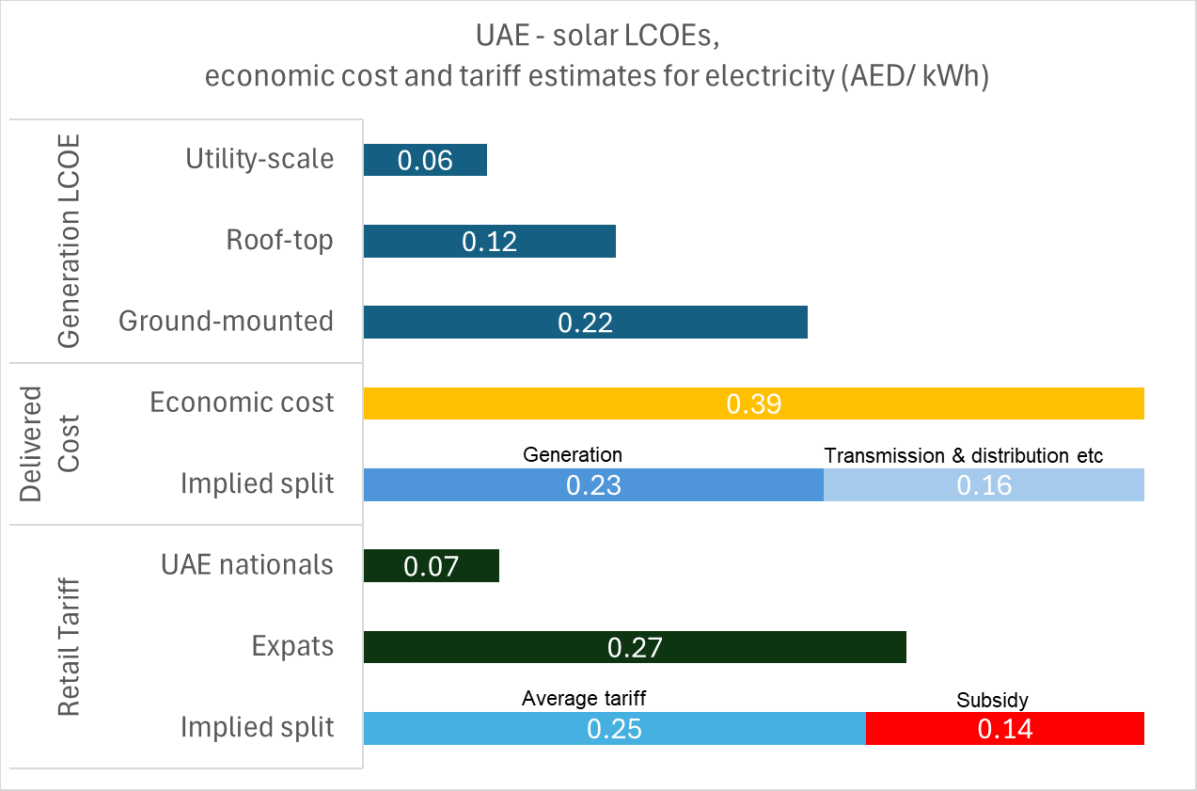
Figure 7: Askar Landfill Site Solar Independent Power Plant

4. But is distributed solar cheap enough?

Until recently, rooftop solar was not viable in Abu Dhabi [11] – the costs were too high. However, that is not true anymore. The cost of rooftop solar has now fallen below the economic cost of electricity.

In fact, distributed rooftop solar costs have *also* fallen below *tariff* levels, for all Abu Dhabi consumers except those receiving the largest subsidy (UAE nationals and Agriculture businesses), as shown in Figure 8.

Figure 8: MCC analysis of LCOE for solar energy projects and comparison with Economic cost of electricity and tariffs in Abu Dhabi



Firstly, we estimate that roof-top solar is very cheap (12 fills/kwh) compared to the economic cost of electricity (39 fills/kwh). The economic benefit is the difference (27 fills/kwh) between the two LCOEs (i.e. 39 minus 12), we estimate. That is huge.

However, roof-top solar (12 fills/kwh) is not cheap enough for UAE nationals on the heavily subsidised retail tariff (7 fills/kwh) or for agricultural consumers (5 fills/kwh) as shown in (Figure 4). Ground-mounted solar (22 fills/kwh) is not *as attractive* to consumers on the expat tariff (27 fills/ kWh) or commercial tariff (30 fills/kwh), but it is still worthwhile because its significantly cheaper than the economic cost (39 fills/kwh).

Figure 9: Roof-top Solar

More formally, for each customer group in Abu Dhabi, we estimate costs and savings, for both roof-top and ground-mounted solar systems. We modelled these and estimated the returns on investment (Internal Rate of Return, IRR) and payback periods (Table 1).

Table 1: MCC analysis of Distributed solar generation - customer groups, respective tariff, size, costs, payback period and IRR

Customer group	Residential: UAE national	Residential: Expat	Commercial	Industry
Base tariff (AED/ kWh)	0.07	0.27	0.20	0.29
Distributed system type	Rooftop	Rooftop	Rooftop	Ground-mounted
Size (kW)	4	4	500	900 - 3,000
Set-up cost[1] ('000 AED)	9.8 - 10.6	9.8 - 10.6	1,224 - 1,326	3,213 - 13,770
Maintenance cost: Year 1 ('000 AED)	0.1	0.1	17 - 18	44 - 187
LCOE (AED/ kWh)	0.11 - 0.12	0.11 - 0.12	0.12 - 0.13	0.17 - 0.22
Payback period (years)	17.6 - 22.8	3.2 - 3.5	4.4 - 4.8	4.5 - 5.9
IRR (25 years)	0.2% - 1.4%	30.8% - 34.0%	20.8% - 23.0%	16.1% - 22.4%

Our analysis for distributed solar generation projects, based on current cost data, shows that rooftop and ground-mounted solar systems can deliver electricity with LCOEs in the range of 11 fills/kWh (roof-top, residential) to 22 fills/kWh (ground-mounted, industry).

We assume that the benefit to the consumer for each kwh equals the retail value (i.e. “Net metering” – the owners are paid the same price for electricity they sell to the grid as electricity they buy from the grid).[2] Notably, the difference in returns and payback analysis is largely due to the subsidy effect, because our table shows the payback and IRR from the

[1] Set-up cost for Rooftop systems of 2,400-2,600 AED/ kW (real, 2024) and for Ground-mounted systems 3,500-4,500 AED/ kW (real, 2024), we assume.
The construction period is 3 months for residential and 6 months for non-residential customers, and UAE CPI of 2% for cashflows starting 2025 (tariff and costs), we assume.
[2] In Abu Dhabi, the Small-scale Solar PV Energy Netting Regulation was issued in 2017. [8]

consumer perspective. If there was no subsidy from the UAE government, the benefits would be larger. Put another way, the IRR for UAE nationals is low (0.2% – 1.4%), but there is a large benefit to the UAE government, as the subsidy would be reduced by the largest amount, 0.32 AED/kwh, as shown in Figure 4. Consumers in the agriculture sector are in a similar situation.

To conclude, distributed solar is cheap enough, to benefit the UAE government (and the economy), in all our scenarios/customer groups. However, distributed solar is not cheap enough to be attractive to consumers on the lowest tariffs (UAE nationals and agricultural customers – i.e. those who receive the largest government subsidies).

5. What are you waiting for?

We estimate that the current installed capacity for distributed solar is less than 0.1 GW in Abu Dhabi - a small number. By contrast, we estimate that the current annual energy requirement of Abu Dhabi exceeds 82.7 TWh [7] – a much bigger number.[3]

Why is distributed solar generation not more popular? We think the main reasons are: 1) the investment benefits have only recently become apparent; 2) the subsidy; 3) rooftop complications; 4) there's inertia; 5) a big-project-bias; 6) consumers not taking a long-term view of ownership (residents) or investment benefits; 7) regulation and government policies are new and/or basic; and 8) residential solar is "not allowed" in Abu Dhabi, sources say.

[3] TAQA annual report states UAE generation of 58,731 GWh (58.7 TWh) is 71% of Abu Dhabi's electricity requirement. Thus, we infer Abu Dhabi's electricity requirement is 82.7 TWh (58.7/ 71%). This also aligns with the Department of Energy price control assumptions for TRANSCO (82,628 GWh for 2023) [9].

Nonetheless, the win-win-win economic case is clear, the desire is there, and the money is there. So, we created three scenarios for distributed solar, to estimate the potential growth in this market and the potential benefits to the UAE government and to the environment.

In scenario C, we assume 30% growth in distributed solar capacity additions per year, with the total generation reaching 3.8 GW by 2030 (Table 2). Scenario C would supply only 10% of energy demand, so it feels very reasonable.

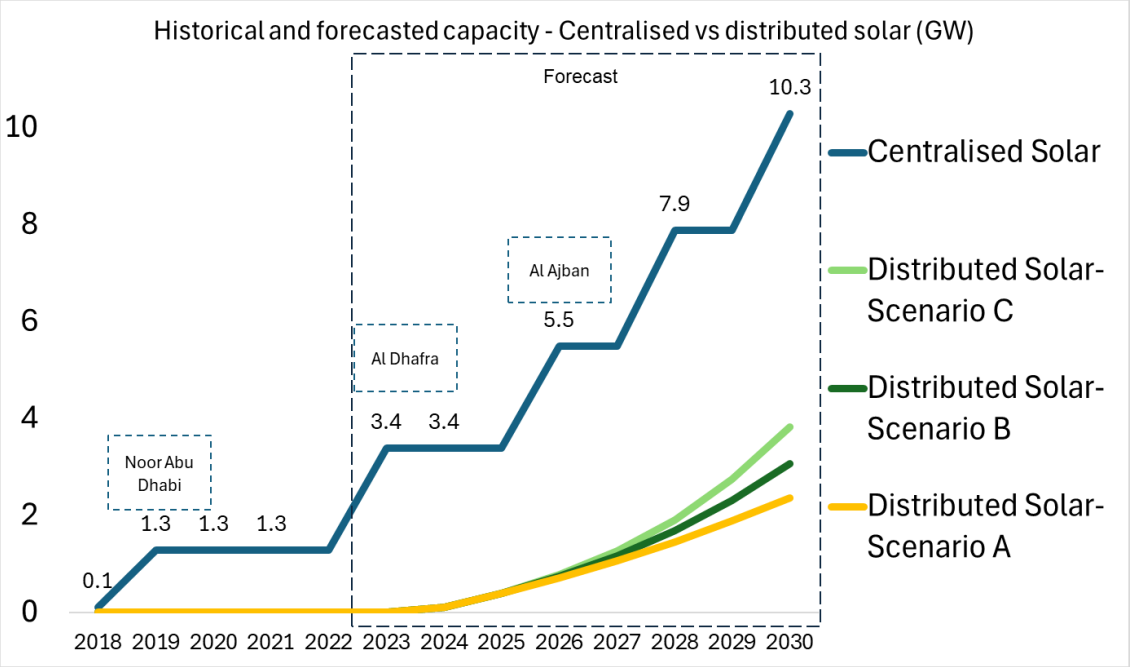
Table 2: Solar adoption scenarios, subsidy reductions and emission reductions

Type	Distributed Solar Generation Scenarios			Centralised Solar
Adoption scenario	A	B	C	Baseline
Capacity in 2024 (GW)	<0.1	<0.1	<0.1	3.4
Incremental annual growth in capacity from 2024 (%)	10%	21%	30%	20%
Capacity by 2030 (GW)	2.4	3.1	3.8	10.3
Total set-up cost - real (bn AED)	5.4-10.2	7.1-13.3	9.0-16.8	8.4[4]
Annual generation in 2030 (GWh)	6,658	8,659	10,823	29,073
Subsidy reduction in 2030 - real (Mn AED)	903	1,175	1,468	3,943
CO2 emissions avoided in 2030 (million tonnes/ year)	3.1	4.0	5.0	13.5

[4] MCC assumption: centralised set-up cost = AED 1,221/ kW DC; excludes grid connection costs, transmission and distribution costs, and financing costs.

In scenario C, the investment in distributed solar would translate into reduction of annual subsidy by AED 1.5 billion (real, 2024 prices) and an annual reduction of 5 million tonnes of carbon emissions in 2030.

Figure 10: Abu Dhabi's solar generation capacity scenarios



Further, the actual economic costs of generation in Abu Dhabi could rise, due to: 1) increasing demand, 2) global inflation uncertainty, 3) additional transmission capex, and 4) the dominance of more expensive natural gas sources in current generation mix.

To conclude, more installations of distributed solar would help Abu Dhabi: 1) reduce its subsidy to the electricity industry, 2) boost its economy, 3) prove its commitment to sustainability, and 4) help it achieve its green objectives.

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