

# PROSPECTS OF ENERGY STORAGE SYSTEMS IN THE GULF

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*This policy brief is part of a series published to examine the relevance of advanced energy systems and concepts in the Middle East. This work has been conducted in partnership with MDS Gulf*

## Summary

With the projected rapid growth in renewables capacity and push for implementing economic reforms in the Gulf countries, the regional market for Energy Storage Systems (ESS) is expected to flourish. The level of cost decline strongly supports the business case for ESS in the Gulf and wider Middle East region, as the lower ends of cost projections would come very close to the current price range of electricity produced by diesel generators. The economic competitiveness of ESS is expected to surpass that of traditional backup power systems within the next five years.

## MAIN RECOMMENDATIONS

- ▶ Energy utilities and large power consumers should adapt their operations and business models to benefit from the various revenue generation channels that would be created by the increasingly economic and practical ESS
- ▶ Even at the currently subsidized levels of domestic fossil fuel prices, there is a substantial added value of incorporating ESS in the energy management of a wide range of economic sectors, particularly those operating in remote areas and off-grid.
- ▶ The economic case for ESS and their level of penetration could be further improved with a shift towards deregulated electricity markets.

## Introduction

The business case for global ESS deployment is improving, thanks to recent substantial cost reductions and performance improvements. In the Gulf countries, the energy and power transformation is underpinned by (1) pressure to diversify energy sources and reduce reliance on fossil fuel; (2) increased urbanization and digitalization; and (3) governmental renewable energy targets coupled with increased global discussion, development, and implementation of new regulations to reduce carbon emissions. However, the deployment of ESS is still facing some serious barriers mainly due to subsidized petroleum prices and the nature of electricity markets.

Since the market size of Energy Storage Systems (ESS) is strongly correlated to the penetration of intermittent renewable energy systems such as wind and solar, the Middle East market for ESS is currently limited. However, with the projected rapid growth in renewables capacity in the wider Middle East and North Africa (MENA) region — particularly in the GCC — in both utility-scale and distributed applications, the regional ESS market is expected to follow suit.

## Market Size

From now until 2025, the MENA region is expected to be the second-fastest growing market for ESS after South Asia, due to the rapidly growing installed capacity of intermittent renewables. Storage is a key component in dealing with intermittency, ensuring flexibility, and improving systems' reliability.

ESS use within the distributed off-grid and grid-tied commercial and industrial market segments is expected to grow at a compound annual growth rate of 23 and 40 percent, respectively (see Table 1), reaching a total combined revenue of 520 million USD in 2025. Assuming that ESS deployment in the GCC will account for 60 to 80 percent of that total, the GCC market size is expected to be between 310 and 420 million USD.

The cost range of the major four storage technologies is projected to continue to decline (see Figure 1). The level of cost decline over the next five years strongly supports the business case for ESS in the Gulf and wider Middle East region, as the lower ends of these projections would come very close to the current cost range for diesel generators.

Assuming that energy reform efforts in the region continue to gain momentum, potentially resulting in a domestic price increase of diesel fuel, the economics of ESS will be become even stronger, not to mention the environmental and social benefits.

MARKET SEGMENT	2018		2025		CAGR
	Capacity (MW)	Revenue (\$M)	Capacity (MW)	Revenue (\$M)	
Utility-Scale	130	570	1190	2600	30%
Off-grid	40	176	210	455	23%
Industrial & Commercial	<5	21	30	65	40%

Table 1: ESS growth in the Middle East (source: Navigant Research)

Positive ESS prospects in the Gulf are driven by:

- ESS costs will likely continue to decline at the same aggressive rate
- Countries across the region, particularly in the GCC, have capitalized on the recent decline in oil and gas revenues to push for reforms that included reduction of fossil fuel subsidies.
- Renewables — and consequently ESS — are expected to benefit from governmental support as part of an attempt to shift away from the “oil economy”. The renewable energy sector is an integral element in all the currently adopted visions across the region.

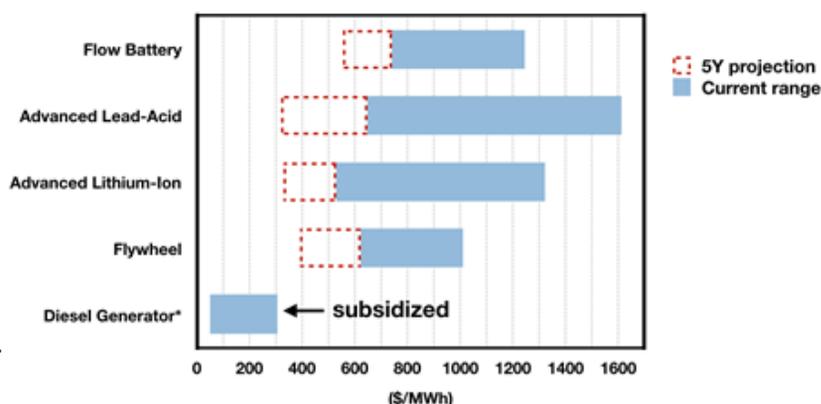
### The Business Case for Distributed ESS in the Gulf

The levelized cost of storage (LCOS) of lithium-ion, advanced lead-acid and flow batteries has decreased by 50, 33, and 43 percent, respectively, just between 2014 and 2017.

Despite such impressive cost reductions, the current cost range of the main storage technologies remains economically uncompetitive vis-à-vis diesel generators, due to the low-cost of diesel fuel, particularly in the Gulf.

Financially speaking, the role of ESS is to reduce the amount of diesel fuel used by conventional backup energy systems. Given the relative economics between ESS and diesel generators, we define a crossover price of diesel fuel. ESS investments would be financially justified if the levelized cost of storage falls below that of the electricity generated by diesel generators (see Table 2).

The five-year crossover price of diesel fuel for the four major storage technologies ranges from 1.56 to 0.67 USD per liter. This range is well within reach, knowing that the current price of diesel in the United Arab Emirates, for example, is 0.63 USD per liter.



\*The lower end of the diesel generator levelized cost represents fuel price of \$0.12/L (KSA) and a capacity of 95%. The higher end represents fuel price of \$0.6/L (UAE) and a capacity factor of 10%

Figure 1: Levelized Cost of Storage in Distributed Systems for Industrial and Commercial Applications

<i>TECHNOLOGY</i>	<i>CURRENT CROSSOVER</i>	<i>5Y CROSSOVER</i>
Flow Battery	2.3	1.56
Advanced Lead Acid	1.93	0.67
Advanced Lithium Ion	1.49	0.67
Flywheel	1.82	0.93

**Table 2: Diesel crossover price for different storage technologies**

The economic case for ESS in the region could be further improved were a shift towards deregulated electricity markets to occur. Even at today's costs, ESS have been very effective in reducing energy costs in deregulated electricity markets, especially for industrial and commercial consumers, as they benefit from replacing grid-supplied peak electricity, which is priced higher than off-peak time periods.

In addition to reducing energy costs, ESS have a large potential role to play when it comes to providing ancillary services such as load-following and frequency regulation. In the case of high penetration of hybrid grid-tied energy systems, providing such services would generate a revenue stream.

***Market Reaction and Early Adopters***

The crossover price can be a powerful indicator of market shifts. However, different sectors and industries are expected to have different reactions in different price environments. Table 3 summarizes three levels of reactions at current crossover diesel prices; i.e., without price incentive to invest in ESS in the GCC.

	<i>SECTOR/INDUSTRY</i>	<i>MAJOR DRIVERS</i>
<b>Early Adopters</b>	Solar/wind utilities	Need for grid services (voltage support and frequency regulation)
	Off-grid oil & gas, telecom - particularly those with established hybrid systems	Significant reductions in maintenance and fuel transport costs
	Independent power producers	Acquiring know-how and adapting to new business model
<b>Fast Followers</b>	Large manufacturing and industrial companies	Reduced maintenance costs, need for system reliability
	IT, data centers and financial corporations	Need for high system reliability
	Public institutions/buildings	PR and promoting positive and modern image
<b>Late Adopters</b>	Residential sector	Lack of applicability and economic incentives
	Hospitality and retail sectors	Limited value proposition at low diesel fuel prices

**Table 3: Predicted market reaction at current crossover diesel prices**

Since ESS intrinsically improve the economics and practicality of existing solar and wind projects in the region, early ESS adopters are likely to be those which have already invested in solar and wind projects. As for the Industrial and Commercial segment, early adopters are expected to be those which would achieve significant non-fuel cost savings by investing in ESS and those which seek to acquire the know-how to adapt to new business models.

## References

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## The Energy Policy and Security Program

The Energy Policy and Security Program at the Issam Fares Institute for Public Policy and International Affairs at AUB was launched in 2016 as a Middle East-based, interdisciplinary platform to examine, inform and impact energy and security policies, regionally and globally. The Program closely monitors the challenges and opportunities of the shift towards alternative energy sources with focus on nuclear power and the Middle East. The Program has been established with a seed grant support from the John D. and Catherine T. MacArthur Foundation to investigate the prospects of nuclear power in the Middle East and its potential to promote regional cooperation as a way to address the security concerns associated with the spread of nuclear power.

## Issam Fares Institute for Public Policy and International Affairs at the American University of Beirut

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We are committed to expanding and deepening policy-relevant knowledge production in and about the Arab region; and to creating a space for the interdisciplinary exchange of ideas among researchers, civil society and policy-makers.

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