

# Market Segment Watch

## Energy Storage in the Middle East

### Table of contents:

<b>List of Figures</b> .....	<b>3</b>
<b>List of Tables</b> .....	<b>4</b>
<b>Saudi Arabia</b> .....	<b>8</b>
<b>1. Key take-away on energy storage</b> .....	<b>8</b>
<b>2. Overview: the Saudi Power System</b> .....	<b>8</b>
2.1. Generation .....	8
2.2. Transmission System.....	12
2.3. Distribution System.....	13
KSA's current and expected electricity supply & demand .....	16
<b>3. Vision 2030: Forging ahead amid uncertainty</b> .....	<b>20</b>
3.1. Renewable Energy Ambitions .....	20
3.2. Responsible programs and bodies .....	21
3.3. Factors driving renewable energy in the KSA .....	21
3.4. Tangible large-scale renewable projects .....	23
3.5. The \$200 billion deal for world's largest solar project .....	24
<b>4. Regional electricity market</b> .....	<b>26</b>
4.1. Electricity Law .....	26
4.2. Electricity Market.....	26
4.3. The GCC: an interregional electricity market.....	29
<b>The United Arab Emirates</b> .....	<b>35</b>
<b>1. Key take-away on energy storage</b> .....	<b>35</b>
1.1. Abu Dhabi.....	35
1.2. Dubai .....	36
<b>2. Overview</b> .....	<b>37</b>
2.1. Regulatory framework .....	37
2.2. Renewable energy .....	37
2.3. Nuclear Energy .....	40
2.4. Waste-to-energy .....	40
<b>3. Abu Dhabi</b> .....	<b>40</b>
3.1. Regulatory framework .....	40

3.2.	Generation .....	41
3.3.	Transmission .....	44
3.4.	Distribution & Supply .....	46
<b>4.</b>	<b>Dubai .....</b>	<b>47</b>
4.1.	Regulatory framework .....	47
4.2.	Generation .....	47
4.3.	Transmission .....	50
4.4.	Distribution & Supply .....	50
<b>5.</b>	<b>Sharjah and the Northern emirates .....</b>	<b>51</b>
5.1.	Northern Emirates .....	51
5.2.	Sharjah .....	51
<b>Jordan .....</b>		<b>54</b>
<b>1.</b>	<b>Key take-away on energy storage .....</b>	<b>54</b>
<b>2.</b>	<b>System Overview .....</b>	<b>56</b>
2.1.	Electricity sector .....	56
2.2.	Generation .....	57
2.3.	Transmission .....	62
2.4.	Distribution and supply .....	66
<b>Egypt .....</b>		<b>71</b>
<b>1.</b>	<b>Key take-away on energy storage .....</b>	<b>71</b>
<b>2.</b>	<b>Overview .....</b>	<b>71</b>
2.1.	Players .....	71
2.2.	Generation .....	73
2.3.	Transmission .....	85
2.4.	Distribution .....	87
<b>Israel .....</b>		<b>91</b>
<b>1.</b>	<b>Key take-away on energy storage .....</b>	<b>91</b>
<b>2.</b>	<b>Israel power status .....</b>	<b>92</b>
<b>3.</b>	<b>Liberalization process .....</b>	<b>92</b>
3.1.	Electricity sector changes .....	93
3.2.	Opportunities for energy projects .....	93
<b>Cyprus .....</b>		<b>95</b>
<b>1.</b>	<b>Key take-away for energy storage .....</b>	<b>95</b>
<b>2.</b>	<b>Electricity landscape .....</b>	<b>96</b>
2.1.	The electricity supply chain .....	96
2.2.	Electricity mix and renewables ambitions .....	96
<b>Turkey .....</b>		<b>99</b>

<b>1. Opportunities for energy storage .....</b>	<b>99</b>
1.1. The market for primary frequency control now accepts energy storage .....	99
1.2. The upcoming tender for large scale solar farms includes a storage component.....	102
<b>2. The Turkish electricity sector.....</b>	<b>103</b>
2.1. The Electricity sector structure and stakeholders .....	103
2.2. The current electricity mix and renewable deployment objectives .....	105
<b>Glossary.....</b>	<b>107</b>

## List of Figures

Figure 1. Share of installed capacity by producer - 2017.....	9
Figure 2. Installed capacity by generator type.....	10
Figure 3. Age of the operational generation units.....	10
Figure 4. Total efficiency of the Saudi generation system.....	11
Figure 5. Quality Indices for countries in the Middle East and other references.....	15
Figure 6. Total energy sales by sector.....	16
Figure 7. Paid fuel prices by Saudi producers versus international prices (in \$/MMBtu) .....	17
Figure 8. Expected evolution of various electrical factors between 2018 and 2030.....	18
Figure 9. Historical peak load in Saudi Arabia.....	19
Figure 10. Current and 2030 expected peak loads in Saudi Arabia and neighboring countries.....	19
Figure 11. Crude oil prices (2007-2018).....	22
Figure 12. 2030 generation base curve sample .....	25
Figure 13. Organizational structure of the current Saudi electricity industry .....	27
Figure 14. Saudi electricity industry after completion of Phase I of the restructuring plan.....	28
Figure 15. Electricity industry structure after full implementation of the plan.....	29
Figure 16. The GCC grid.....	30
Figure 17. Electricity market structure in the GCC and neighboring countries .....	31
Figure 18. Cross-border interconnections in GCC and neighboring countries .....	32
Figure 19. Power trading on GCCIA interconnections .....	32
Figure 20. UAE 2050 energy goals .....	38
Figure 21. Principles of sector costs.....	41
Figure 22. Global Electricity Capacity & Generation (2017) .....	43
Figure 23. Evolution of installed capacity & generation .....	44
Figure 24. The Abu Dhabi Electricity System .....	45
Figure 25. Installed generation capacity and IPP penetration.....	48
Figure 26. Peak Load in the different emirates.....	52
Figure 27. Energy consumption in the different emirates.....	52
Figure 28. Operation reserves .....	55
Figure 29. Contribution of renewable and primary energy sources in electricity generation .....	57
Figure 30. Activation thresholds of the different operating reserves .....	65
Figure 31. Evolution of electricity generation and consumption from 2004/05 to 2015/16 .....	73
Figure 32. Installed capacity and peak load (MW).....	74
Figure 33. Installed generation capacity by structure and type (30/6/2017).....	75
Figure 34. Generated renewable energy (GWh).....	80
Figure 35. IRENA's model for the future Egyptian generation mix.....	85
Figure 36. African power pools .....	86
Figure 37. Vision for Egypt as a regional power hub .....	87
Figure 38. Power production and fuel share in the electricity generation.....	92
Figure 39. Evolution of Cyprus electricity generation capacity .....	97

Figure 40. Past remuneration levels of the primary frequency control service .....	100
Figure 41. Prices of the primary frequency control in Q2 2018.....	101
Figure 42. Feed-in Tariffs in application in Turkey.....	102
Figure 43. History of the liberalization of the electricity sector in Turkey .....	104
Figure 44. Organization of the Turkish electricity sector.....	105
Figure 45. Installed generation capacity in Turkey, as of 2017 .....	105
Figure 46. Planned renewable generation capacity to be added over the 2018-2023 period.....	106

## List of Tables

Table 1. Transmission system standard service voltages .....	12
Table 2. Operational frequency margins set by the Saudi Grid Code.....	13
Table 3. Distribution system standard service voltages .....	13
Table 4. Comparison of electricity quality indices.....	14
Table 5. Evolution of the Saudi electricity tariff .....	17
Table 6. Key players in Saudi Arabia .....	21
Table 7. The three first renewable projects in the KSA .....	24
Table 8. Renewable energy: potential and future .....	38
Table 9. Installed solar capacity in MW .....	39
Table 10. Operational and upcoming RE projects .....	39
Table 11. Global Electricity Capacity & Generation (2017).....	42
Table 12. Evolution of installed capacity & generation .....	43
Table 13. Electricity exported by Abu Dhabi (ADWEA) at global peak time .....	45
Table 14. Yearly Energy exported by ADWEA .....	45
Table 15. Residential tariffs .....	46
Table 16. Non-residential tariffs .....	47
Table 17. SEWA total energy production (GWh) .....	51
Table 18. Generated energy by resource type for Jordan .....	57
Table 19. Generation landscape in Jordan.....	58
Table 20. Renewable energy: potential and future .....	59
Table 21. Renewable Energy Projects (2015-2018) .....	60
Table 22. Future Renewable Energy Projects (2019-2021) .....	60
Table 23. Number of net-metering customers and total installed capacity .....	61
Table 24. Jordan's Vision 2025 target scenario .....	62
Table 25. Operating reserves.....	65
Table 26. Primary reserve allocation principles in Jordan .....	65
Table 27. DSOs in Jordan .....	66
Table 28. Bulk Supply Tariff (2017/2018) .....	67
Table 29. Electricity retail tariffs.....	68
Table 30. Key players in the Egyptian power landscape.....	73
Table 31. Installed capacity by type and generating structure.....	74
Table 32. Main characteristics of the Egyptian electricity sector (2015-2017) .....	76
Table 33. Installed Capacity and Energy Generated from Isolated Power Plants.....	77
Table 34. Egyptian power plants.....	78
Table 35. Renewable energy: potential and future .....	79
Table 36. Planned wind projects up to 2023 .....	80
Table 37. Planned Solar Projects .....	81
Table 38. Small-scale PV distributed initiatives.....	82
Table 39. Overview of policies, legislation and regulations supporting renewable energy .....	83
Table 40. Main goals of Vision 2030 .....	84
Table 41. Interconnections for Egypt.....	86
Table 42. Electricity tariffs in Egypt .....	88