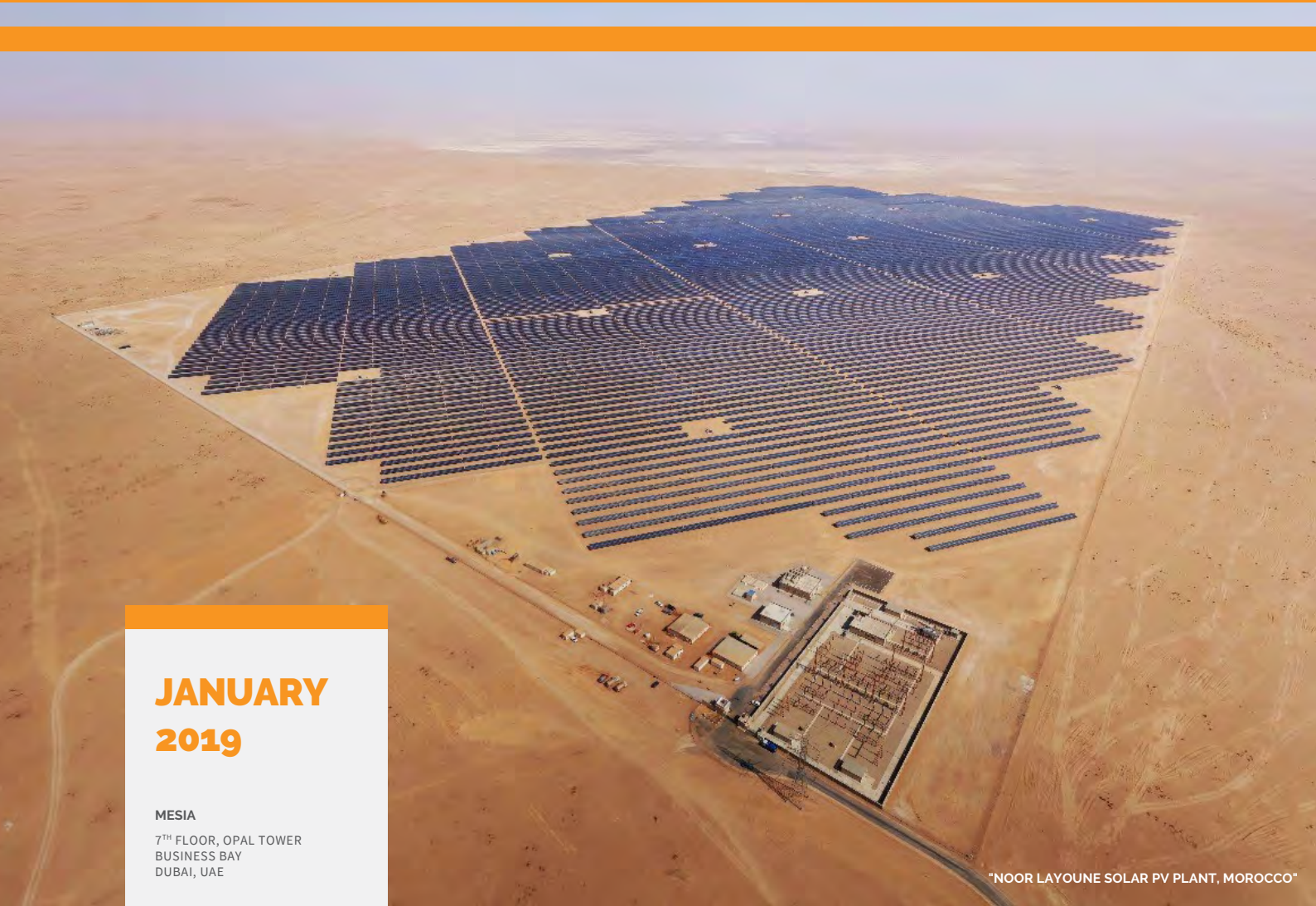


# SOLAR OUTLOOK REPORT 2019

MIDDLE EAST SOLAR INDUSTRY ASSOCIATION



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## FOREWORD

Ten Years Later...

In 2009, the Emirates Solar Industry Association (ESIA) was created based on the belief that there was a role to play for solar in the UAE's power generation mix. Back then all the utilities were shaking their heads at solar. They saw it as an expensive toy and were reluctant to shift away from fossil fuels for their electricity generation. In those early days, it was even difficult to meet with government officials. Gradually the energy fundamentals started to shift, pointing to two very powerful trends.

Firstly, solar technology was improving and becoming more reliable and affordable. Secondly, it was becoming increasingly apparent that depending purely on fossil fuels for electricity generation was not a sustainable long-term solution. From this moment onwards the collaboration with regional utilities, most notably DEWA, began.

In 2012, ESIA signed a landmark partnership with H.E. Saeed Al Tayer, MD and CEO of DEWA, to design, install and operate two rooftop solar pilot projects by pooling the collective know-how and resources of ESIA's members such as Alsa Solar, Enviromena, Hilti, ABB and Chadbourne & Parke (now Covington & Burling). The first pilot project was a modest residential rooftop unit, whereas the second pilot project was a commercial scale system that was installed at the heart of DEWA's Jebel Ali natural gas power plant. It was a vivid symbol that change was coming. Having been assured of the reliability of solar and its downward cost curve, DEWA decided to go all-in and adopted a leadership role in adopting both utility-scale and rooftop solar programs over the years that followed.

Half way through our existence, as solar became 'cool', ESIA decided to broaden its scope and promulgate the advantage of solar technology across the entire MENA region. As a result, ESIA was transformed into MESIA. Mimicking what was done in Dubai, MESIA started working with the utilities and regulators across the region, encouraging them to adopt solar policies that would enable them to draw on the many direct and indirect benefits of solar technology.

Through pioneering trade missions to Egypt, Jordan, Pakistan and Saudi Arabia, we fostered relationships and trust between the government stakeholders and the private sector players. In Egypt alone, MESIA helped facilitate the inward investment of \$500 million in the country's solar sector. Those four markets have since become major hubs for solar power, with over an impressive 5,000MW of solar power that is already operating, awarded or under construction.

As we look ahead to the next 10 years, more work remains to be done. Today, solar power is attractive when the sun is shining but at night, its glitter fades. The solution is storage. And just like solar panel technology improved rapidly and became a mainstream solution for power generation, so will solar storage in terms of providing on-demand energy, 24 hours a day. Today, adding storage capacity means doubling the capital cost of solar systems. It is our belief that within the next few years, the cost of solar combined with storage will be far less than that of fossil fuel power generation.

These innovations and private-public partnerships would not be possible if not for the 200+ companies that have supported MESIA over these past 10 years and the government regulators and utilities that gave us the chance to showcase the power of solar. Thanks to this collaboration, solar is here to stay and is poised to continue growing as a source of clean, sustainable and affordable power for decades to come. The solar future is shining bright!

Onwards & upwards.

**VAHID FOTUHI**  
Founder, MESIA

# 1. INTRODUCTION

Solar energy has continued to gain momentum globally and in the MENA region. As of H1 2018, over 470 GW of solar PV was installed worldwide, and 100 GW alone was added in 2017 (Figure 1). Within MENA, growing populations, economic growth and increased industrial activity have led to rising electricity demand. Since 2013, the population in the region has grown by almost 8%<sup>1</sup> and is set to continue growing, adding increased pressure on existing power assets.

**OVER  
470  
GW OF  
SOLAR  
PV**

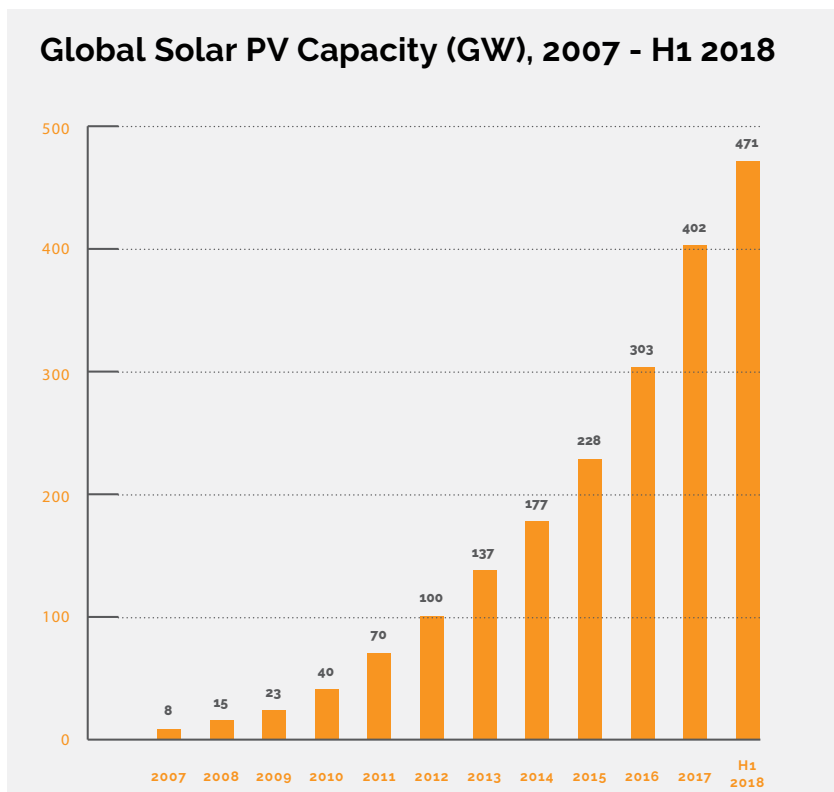


Figure 1: Globally Installed PV Capacity, 2007 – H1 2018 (Source: REN21, Bloomberg NEF)

As MENA countries move towards achieving their respective renewable energy targets, below are some of the major highlights from 2018:

- The 200 MW Kom Ombo solar PV project in Egypt and Jordan’s Round 3 PV auction both received bids below 3 US\$ cent/kWh. In addition, the Egyptian government has requested bids no higher than 2.5 US\$ cent/kWh for the ongoing 600 MW solar PV West of Nile tender
- Saudi Arabia’s 300 MW solar PV Sakaka project, the first utility scale project in the country, was awarded at 2.34 US\$ cent/kWh and began construction in November 2018
- Jordan and Lebanon are in the process of awarding some of the first energy storage tenders in the region
- Morocco’s 580 MW Noor II and III projects at the Ouarzazate solar complex, one of the largest in the world to consist of PV and CSP, are due to be completed by the end of 2018

<sup>1</sup>World Bank

Energy storage solutions are becoming more competitive as PV panel prices (now hovering at/below 25 US\$ cents/watt) and battery pack prices continue to decline. Solar PV plants integrated with battery storage are starting to offer LCOE's competitive with fossil fuel plants. The same goes for concentrated solar power (CSP) plants, which are also experiencing rapid cost declines. We're expecting increased activity in the distributed generation segment, especially as electricity subsidies continue to be phased out, new financing options emerge and customer awareness of solar solutions increases. We also anticipate a significant increase in electric vehicle uptake but, except for a few markets, we would need to see more regulations and incentives to promote wider use.

By reading this report, our goal is to ensure that you get a grasp on the major trends and technologies that will affect the MENA solar industry over the next few years and that you understand the major developments, challenges and opportunities in each of the countries we've covered. We would like to thank everyone who contributed, commented and reviewed this report, without whom this research effort would not have been possible.



**KANAV DUGGAL**  
 Manager of Research and Content, MESIA  
 On behalf of the MESIA Board

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## 2. INVESTMENT IN RENEWABLE ENERGY

Before we take a closer look at the latest developments in MENA's solar industry, it is important to understand how financial investment and guidance have helped nurture the industry within many of the region's emerging markets.

Global investment in solar projects has increased dramatically over the last 12 years (Figure 2). Investment in renewable energy projects within the MENA region has grown more recently considering the clean energy targets implemented by various countries and dramatic fall in the cost of solar energy. Most of the support for renewable projects has come through government-backed programs bolstered by the willingness of development finance institutions (DFI's) to advise and fund these projects. As an example, the World Bank Group's lending arm, the International Finance Corporation (IFC), has provided nearly \$6 billion in capital for 250 renewable energy projects in emerging markets (5 GW solar and 4 GW wind)<sup>2</sup>.

**\$6**  
**BILLION**  
 IN CAPITAL  
 FOR 250  
 RENEWABLE  
 ENERGY PROJECTS

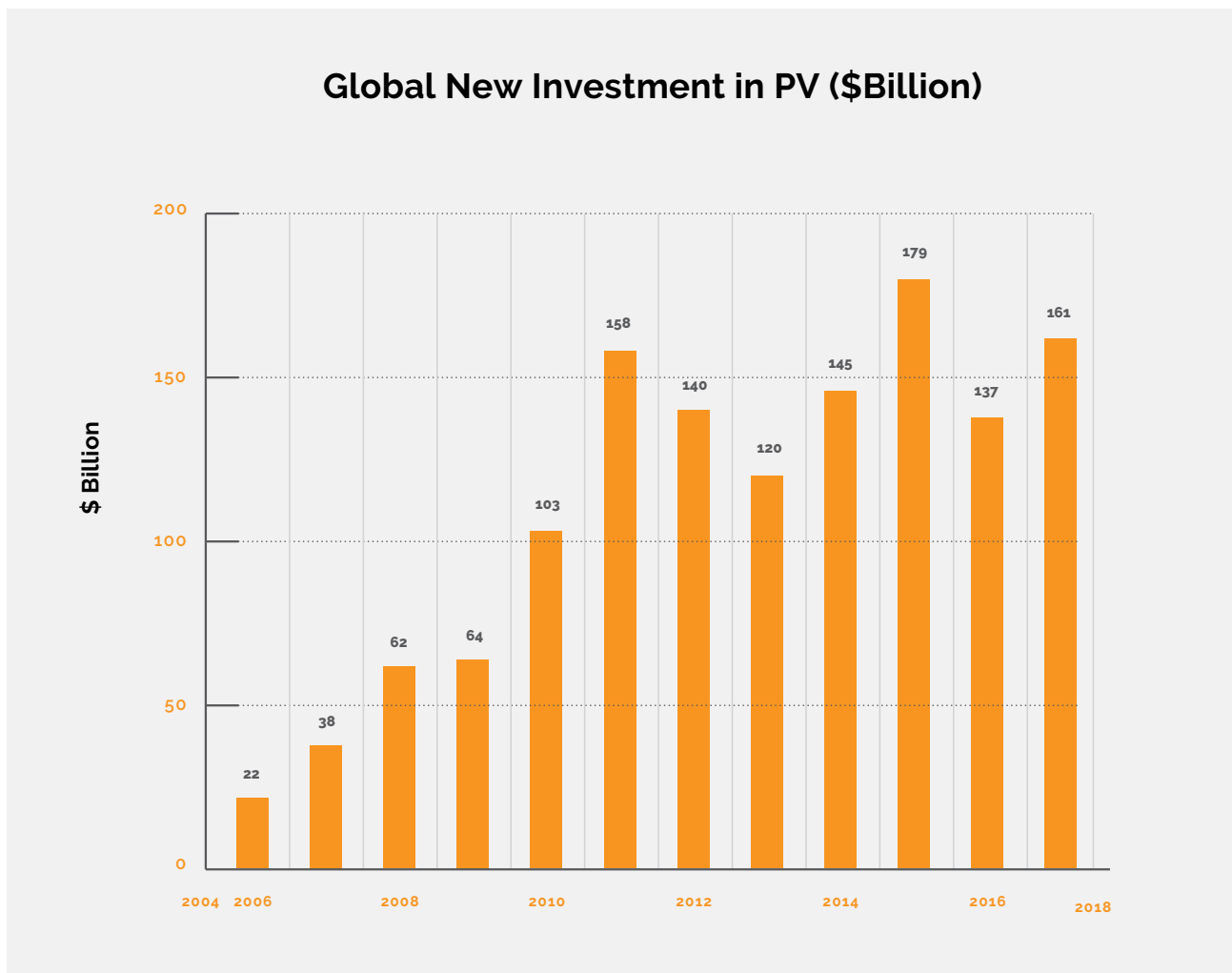


Figure 2: Global Investment in Solar PV Projects (Source: Bloomberg NEF)

<sup>2</sup> IFC

DFIs are important to the financing landscape in the region as support from



# 250 RENEWABLE ENERGY PROJECTS

local and international lenders (outside the GCC) have historically been limited because of:

DFIs have the capability to take on more risk to support local governments' development goals. Their involvement in renewable energy projects will continue to be necessary, at least in the short term.

This type of financing in markets like Egypt, Jordan and Morocco has helped address regulatory risks and improve the investment climate. Jordan is arguably the most established solar market while Egypt, also supported by DFIs like IFC, has leap-frogged with what will be one of the largest solar facilities in the world at its 2,300 MWP/1,800MWAC Benban Solar Park. The IFC's experience in Jordan has laid the groundwork for other countries in the region.

"In creating the IFC's 'Nubian Suns Renewable Energy Program' to support our clients' 13 Egypt feed-in tariff FIT projects, we drew massively from our experience a few years earlier in Jordan," said Christopher Cantelmi, Principal at IFC. "Both Nubian Suns in Egypt and Seven Sisters in Jordan recognized and delivered for our clients a standardized, cost effective solution to quickly bulk process a host of transactions in parallel."

Although regional governments want to develop their renewable energy markets further, some of the challenges facing solar energy deployment are:

1. Lack of available government resources
  - State owned utilities in some countries want to keep a firm grasp over the power sector and are hesitant to liberalize their energy sectors
2. Unrealistic Expectations
  - Countries need to set expectations for tender prices based on their own risk profiles, not on tender results achieved in other countries
3. Subsidy Reform
  - In the long run, energy subsidies are unsustainable so reform is a necessary measure that will help countries become energy independent. However, reform, if not implemented with an adequate safety net to protect the poorest segments, may cause public unrest

Despite these challenges, we are optimistic that entities in both the public and private sectors will continue to invest in solar energy projects throughout the region to help grow the industry further.



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## 3. SOLAR TRENDS 2019 - 2021

Rapid innovation has allowed solar technologies to evolve quickly and cheaply, thus enabling solar energy to become a competitive power generation source. Here we examine some of the major trends we expect will affect the industry over the next three years. Some of these topics are discussed in greater detail in later sections.

- 1. DECREASED PANEL PRICES, FOR NOW:** In June 2018, the Chinese government announced it would halt utility and distributed scale PV project development, effectively creating a supply glut and further reducing global module prices. In the short term, this may have caused developers and EPCs to delay purchases or re-negotiate PPAs, in anticipation of additional price drops. While there is room for further price declines, we could see prices stabilize or even increase slightly should manufacturers adjust production accordingly.
- 2. GROWTH IN ENERGY STORAGE SOLUTIONS:** Energy storage solutions are going to become an integral part of the future energy mix, especially because of the amount of renewable energy being injected into regional grids. Battery prices have decreased almost 80% since 2010 and are expected to drop another 66% by 2030<sup>3</sup>. We are seeing countries begin to tender or experiment with pilot solar PV projects integrated with battery storage (e.g. Jordan, Lebanon and UAE). See **Section 5** for more in depth information on solar PV plus storage.
- 3. Emergence of new PV technologies:**

### High Efficiency Panels – Bi-Facial and Mono facial

Bi-facial PV panels can generate electricity from both sides of a module and can produce anywhere between 15-25% more electricity than conventional mono-facial modules. This can reduce project LCOEs and/or increase internal rates of return (IRR). These panels are still new to the market with little deployment beyond pilot projects, but many of the largest module manufacturers have announced plans to manufacture bi-facial panels at scale. Therefore, we are likely to see wide scale implementation closer to 2020, especially once international standards are developed to determine total power output. Given the rapid pace of technological innovation in the PV industry, we also expect to see panel manufacturers continue to release different iterations of high efficiency mono facial modules.

### Half Cut Cells

Commercialization of half cut PV cells is beginning to occur at scale. Half cut cells can decrease power losses by reducing cell current which increases module power output by about 2-3%. Half cut cells are more efficient in areas subject to high amounts of shading and can lower EPC costs and balance of system (BOS) costs, thus increasing IRRs and lowering LCOEs. Half cut cells can be used with a range of cell technologies, including Poly (PERC), Mono (PERC), Mono (PERT) and perhaps even Bi-Facial cells.

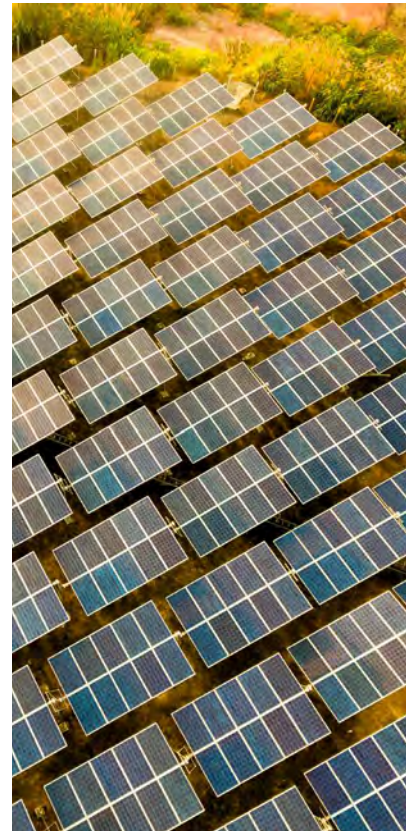
### Building Integrated Photovoltaics (BIPV)

While more established in Europe, BIPV is a concept of growing interest in the region, even though only a handful of projects currently exist. Much work should be done to develop appropriate regulations, safety standards and lab testing protocols. Over the next few years, we're expecting to see a baseline level of regulation implemented in some regional markets.

BETWEEN  
15-25%  
MORE ELECTRICITY  
THAN CONVENTIONAL  
MONO-FACIAL  
MODULES

<sup>3</sup>Bloomberg NEF

- 4. **GROWTH IN EV SALES:** Electric vehicle (EV) sales are expected to increase over the foreseeable future. Some of the world's largest auto manufacturers are beginning to produce EVs at scale and have already begun to enter the MENA markets. The UAE and Jordan are the most established markets for EVs but we're seeing interest in other markets like Oman, Saudi Arabia and Pakistan. See **Section 6** for more in depth information on EVs.
- 5. **FURTHER GROWTH IN DISTRIBUTED GENERATION:** We expect to see continued growth of distributed PV solutions, especially across the C&I and off-grid segments. Subsidy reform, appropriate legislation (e.g. net metering and wheeling) and increased consumer awareness are all factors that are vital to ensuring further growth.
- 6. **INCREASED FOCUS ON ENERGY PLANNING:** Even though renewable energy installations are increasing, oil, gas, coal fired and nuclear plants will also make up an integral part of the generation mix. Therefore, we expect to see countries spend more time on energy planning to determine the optimal mix of renewable and non-renewable energy sources that is country-specific.



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# 4. SOLAR PROJECTS 2019 - 2021

Each year we examine project pipelines in the countries we cover to understand how these markets are progressing.

Table 1 below provides the total MW of solar projects (PV, CSP, ISCC and EOR) across the region in 2018 that were (i) awarded or under tender, (ii) under construction and (iii) in operations. With some exceptions, projects under 10 MW were not included.

Country	Awarded / Tender	Construction	Operations
Algeria	200		368
Bahrain	100		
Egypt	1000	1800	94
Jordan	252	617	641 <sup>4</sup>
Kuwait	1500	60	
Morocco	800	120	705
Oman	600	1021 <sup>5</sup>	
Pakistan		462.52	445 <sup>6</sup>
Saudi Arabia	30	360	98 <sup>7</sup>
Tunisia	644		10
UAE	950	1777	573 <sup>8</sup>
<b>Total</b>		<b>12,294</b>	<b>2,934</b>

Table 1: Solar (PV, CSP, ISCC) Installation overview in MW, excluding projects below 10 MW (Source: MESIA)

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<sup>4</sup>Includes projects below 10 MW

<sup>5</sup>This is an EOR project, measured in MWt  
<sup>6</sup>Includes projects below 10 MW

<sup>7</sup>Includes projects below 10 MW  
<sup>8</sup>Includes projects below 10 MW

Expanding on the figure above, Table 2 below provides updates on specific projects:

Project	Country	Capacity (MW)	Status
CREG PV IPP	Algeria	150	Bid Stage
Solar PV EPC	Algeria	50	Bid Stage
Algeria PV	Algeria	4000	Announced
Askar PV IPP	Bahrain	100	Bid Stage
West Nile PV IPP	Egypt	600	Bid Stage
West Nile PV IPP 2	Egypt	200	Bid Stage
Kom Ombo PV IPP	Egypt	200	Bid Stage
West Nile CSP IPP	Egypt	100	Announced
Round 3 Solar PV	Jordan	150	Bid Stage
RAI Solar PV	Jordan	50	Awarded
KNPC	Kuwait	1500	Bid Stage
Noor Midelt PV	Morocco	800	Bid Stage
Ibri	Oman	500	Bid Stage
Solar PV 2022	Oman	500 - 1000	Announced
Amin PV	Oman	100	Awarded
Sindh Solar Energy Project	Pakistan	420	Announced
Sakaka PV	Saudi Arabia	300	Construction
NADEC PV	Saudi Arabia	30	Awarded
ANME Solar Park	Tunisia	1700	Announced
Tunisia Authorization Scheme	Tunisia	64	Awarded
Tunisia PV - Round 1 Auction	Tunisia	500	Bid Stage
Tunisia PV - Round 2 Auction	Tunisia	70	Bid Stage
Sweihan II PV	UAE	1500 <sup>6</sup>	Announced
DEWA Phase V CSP	UAE	300	Announced

Table 2: Project Updates – 2018 (Source: MESIA)

<sup>6</sup>Subject to change



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- Morocco: 175.5 MWp
- Kenya: 104 MWp
- Namibia: 48 MWp
- Egypt: 322 MWp
- South Africa: 175 MWp
- Zambia: 54 MWp
- Niger: 7 MWp

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*\*Image of World's largest single location solar PV plant (Under-Construction) in Sweihan, Emirate of Abu Dhabi.*

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## 5. ENERGY STORAGE

Energy storage has become one of the most widely discussed topics because of the inherent intermittency of renewables.

Storage solutions allow greater management of renewables connected to the grid and will become necessary to allow increased renewable energy deployment.

Historically, pumped hydro has been the most widely used form of energy storage (Figure 3) but in this section we examine how solar PV plus storage and CSP can influence the energy storage landscape

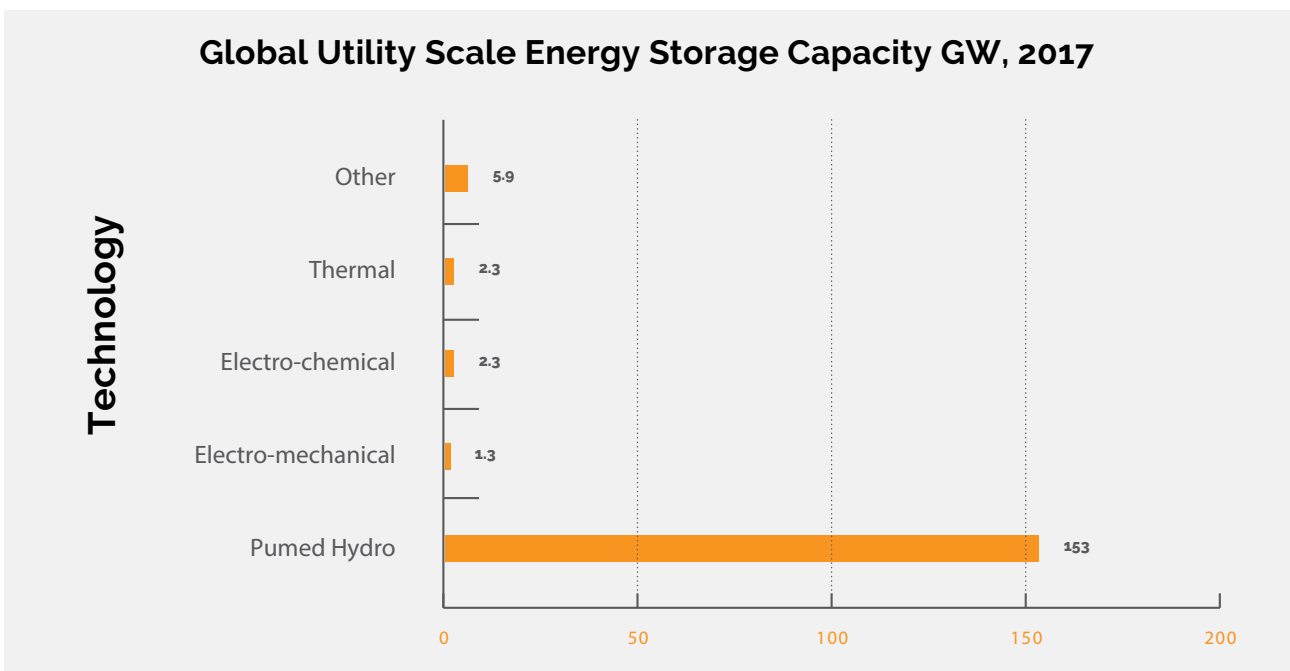


Figure 3: Global energy storage capacity, 2017 (Source: REN21, US DOE)

**PUMPED HYDRO HAS BEEN THE MOST WIDELY USED FORM OF ENERGY STORAGE**

### 5.1 SOLAR PV PLUS STORAGE

Even though the power makeup in the MENA region is still almost exclusively dominated by oil and gas, the falling cost of lithium ion battery packs (Figure 4) will result in the use of solar-plus-storage solutions as a means of dispatchable power. This will allow deeper penetration of solar energy into the generation mix and a decreased utilization factor of conventionally dispatchable power plants.

Even though other storage technologies are becoming cost competitive, lithium-ion batteries are the most commonly used. Solar PV will soon be able to meet daytime electricity demand while batteries can absorb excess generation and discharge power when the sun isn't shining. However, oil and gas plants at low availability factors will still be available to provide baseload generation when solar energy is unable.

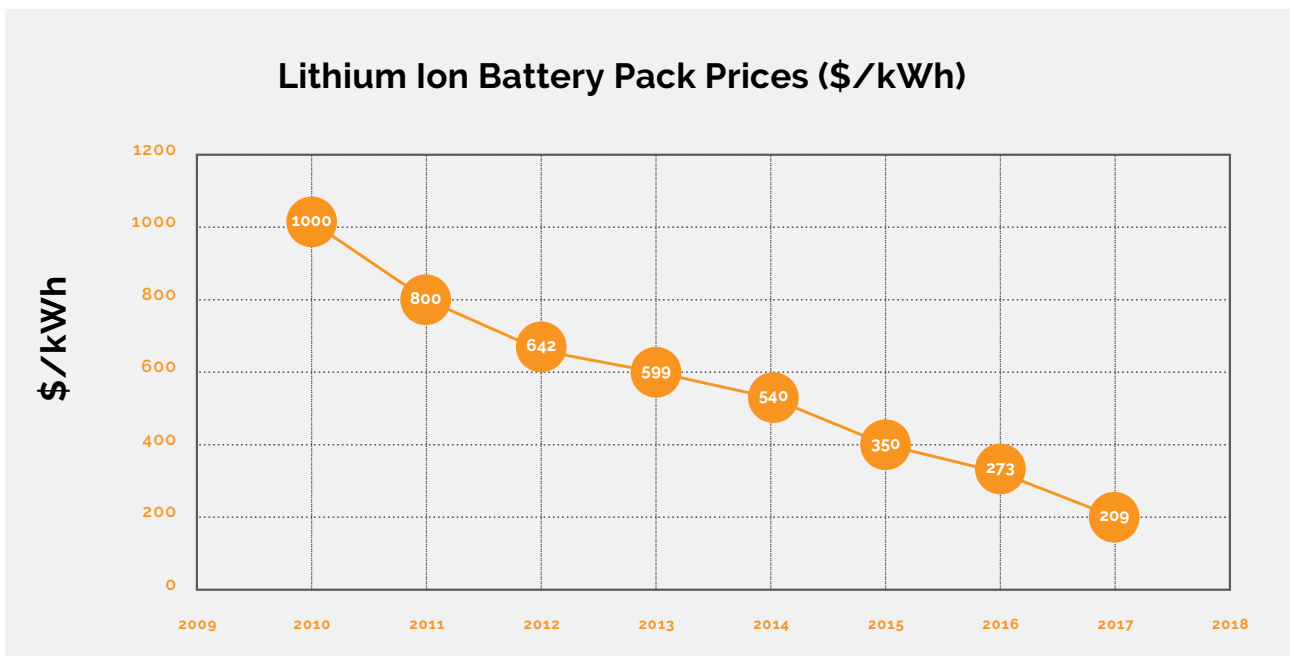


Figure 4: Trend in Lithium-Ion Battery Pack Prices, 2010 - 2017 (Source: Bloomberg NEF)

Dispatchable renewable energy is a major strength of the solar-plus-storage model. Other advantages offered by batteries that make them suitable for other energy storage applications include:

- **RENEWABLE ENERGY INTEGRATION**
- **LOAD SHIFTING**
- **PEAK SHAVING**
- **FREQUENCY CONTROL**

Integrating battery storage with solar plants results in improved economics and makes the intermittent solar plant even more responsible with its ability to ramp up quickly and adjust with real-time grid signals. Depending on the technology, batteries can act as quickly as a few milliseconds (in the case of Li-Ion), which is a faster response time than that of gas turbine generators. Battery versatility is also reflected in the energy management software (EMS) which can be re-configured to add new functions/applications to the battery system in the future, provided it is capable of handling these adjustments.

To maximize investment values, batteries can be used for multiple applications through value stacking. Value stacking is challenging in regulated markets with flat tariffs because revenue streams are limited (no ancillary services or arbitrage revenues), which in turn may limit the scale of deployment of battery energy storage solutions (BESS) in the region. However, there are opportunities for renewable integration especially in off-grid areas (remote areas in Saudi and Oman, construction sites etc.) where PV combined with batteries can replace diesel gensets.

At this point in time, a disadvantage of the solar-plus-storage business model is the relatively uncertain revenue streams. This is because battery storage is a relatively new technology when paired with solar plants. This makes project financing a challenge, with lenders weary without proven viability of returns. There are also no standardized or unified performance measurements for such projects to use to evaluate projects or conduct risk assessments. However, this is the case for many new technologies and is probably not going to affect the storage market in the long run. Other storage technologies are also being researched and could compete with Li-Ion in the long term, but over the next few years, Li-Ion will remain the dominant technology.

The constantly decreasing cost of battery packs, advancements in Li-Ion battery technology, growing interest from developers and regulatory support presents growing

opportunities for battery storage in the Middle East market. With heightened awareness to embrace clean energy for sustainable growth complimented with falling LCOEs for solar, the share of renewable energy in the Middle East's energy mix will increase exponentially. This will require deployment of battery storage to help the grid absorb this large amount of clean energy which is why energy storage is emerging as an integral component to building resilient and efficient grid systems.

#### Recent Developments:

Ongoing trends show that battery storage deployed in the Middle East region will mostly be co-located with large scale PV projects to add value to existing or upcoming solar projects and inject dispatchable solar energy into the grid.

**LEBANON:** In April 2018 Lebanon came up with plans to hold its first PV plus Battery storage auction, through three individual projects with a minimum capacity of 70 MWp and maximum capacity of 100 MWp. Lebanon Center for Energy Conservation (LCEC) has unveiled the names of the 75 consortiums that have expressed interest. These projects are expected to be commissioned between 2021 and 2025.

**JORDAN:** The country was one of the first in the region to issue tenders including battery storage projects. The 12 MW PV and integrated 12 MWh Li-Ion battery project reached financial close in May 2018 and another, 30 MW/60MWh energy storage project is being procured, with bid submissions due in December 2018.

**DUBAI:** DEWA is testing a 1.2MW/7.2MWh sodium sulphur battery energy storage system (NaS BESS), at the Mohamed Bin Rashid Solar Park and has also released an EOI for a 1.12MW/8MWh Li-Ion storage solution. These projects will help DEWA evaluate the technical and economic capabilities and characteristics of stationary energy storage technology integrated with PV arrays and see how it will increase network flexibility.







Signing ceremony between CMI and the Shanghai Electric – Brightsource Joint Venture, in CMI Headquarters in Seraing, Belgium

CMI has been awarded, early October 2018, the design and supply of the solar receiver for the prestigious fourth phase of DEWA's Mohammed bin Rashid Al Maktoum Solar Park in Dubai. This ambitious renewable energy project will include the world's tallest solar tower, with an installed power of 100 MW and energy storage facilities. The CMI solar receiver, a jewel of technology, installed on top of this gigantic tower, will collect the intense concentrated solar energy coming from thousands of mirrors on the ground. In the light of the numerous technological and economical challenges, this new solar receiver is truly one of the finest examples of CMI's cutting edge technology associated with high competitiveness.

This gigantic 4th phase, better known as the «DEWA project», after the Dubai Electricity and Water Authority, the Dubai authority at the centre of this great project, is unquestionably the project of the year for the global CSP industry. During the past 18 months, the industry's titans have clashed to obtain this flagship project. ACWA Power finally won the contract, shattering all the price records for CSP produced energy. ACWA Power is one of the world's largest developers of CSP solar power plants, especially when looking at the Noor 1, 2 and 3 power plants currently under construction in Morocco. ACWA Power has worked in collaboration with the Chinese group Shanghai Electric, in the role of EPC (Engineering Procurement and Construction) contractor, which Joint Venture with Brightsource is CMI customer.

### 5.2 CONCENTRATED SOLAR POWER

CSP plants are proving to be a cost competitive power generation source with 5 GW of projects operating globally. Yet MENA countries are responsible for only 7% of that capacity.

While Morocco, Oman and the UAE have been early adopters of large scale CSP, other regional countries like Egypt, Jordan and Kuwait have or are looking to implement utility scale projects (Figure 5).

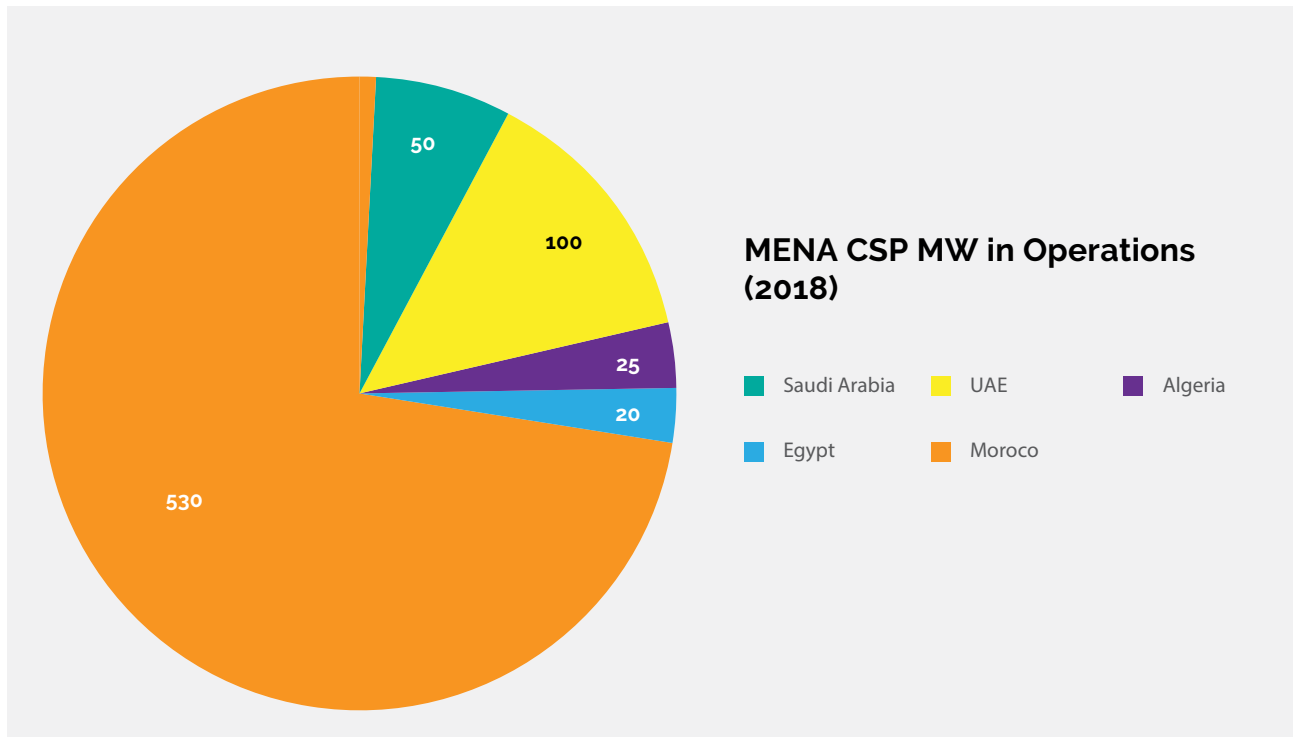


Figure 5: Operating CSP Projects – MENA (Source: MESIA)



"Noor III Ouarzazate CSP Plant, Morocco"

CSP, given its storage capabilities, offers an almost round the clock energy solution. While parabolic trough and tower technologies are expected to be the dominant technologies, at least on the utility scale over the next two to five years, there is a lot of research being conducted and pilot projects being launched to explore different variations of CSP technologies.

Through its emergence into the regional utility scale segment, CSP has faced several challenges. These include:

#### INACCURATE COMPARISONS:

- CSP should be compared to PV plus storage, not PV alone, because of the storage capabilities it offers
- In many cases, CSP can outcompete PV plus storage in terms of price; however this may change depending on how fast battery prices decline

#### IMPLEMENTATION:

- Time required to build CSP plants is significantly longer than time required to build PV plants

- Projects are currently procured individually via tenders and bids that can take two years to be awarded so there no fast track way to implement CSP
- Legislation can take time to develop and must be sturdy enough to provide comfort to lenders

#### LIMITED TRACK RECORD:

- Few active CSP players; more of a niche technology
- Drastic cost reductions, seen with PV plants, have not yet been achieved, but this could change over time as the Chinese market develops further

Government bodies responsible for procuring renewable energy projects should raise awareness about the advantages CSP can offer (i.e dispatchable energy at competitive tariffs). CSP project costs have decreased, almost ten-fold, in the last four years and are continuing to trend downward as more CSP initiatives and projects are shaping up. This is reflected by the tariffs achieved in recent tenders in the region (Figure 6).

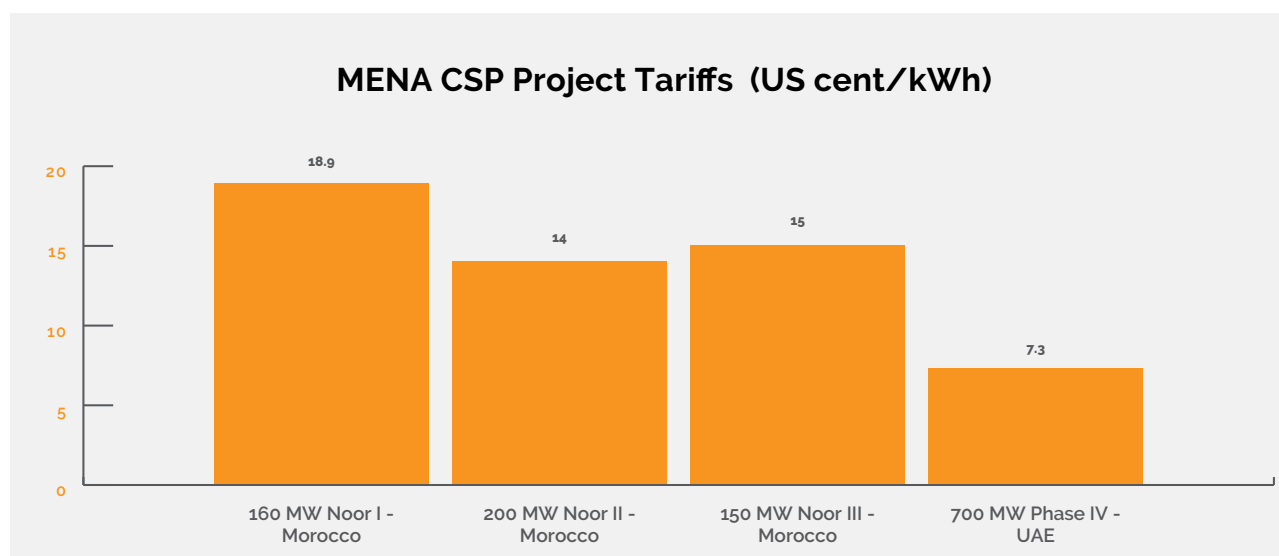


Figure 6: Operating CSP Projects – MENA (Source: MESIA)

As noted above, the recent rise of the Chinese CSP market could act as a major shift in technology adoption and cost reduction, thanks to the volumes achieved in the first round of demonstration projects (approximately 1 GW). The Chinese government plans to support the development of 5 GW of CSP by 2020, which is roughly equal to the global capacity operating today. Therefore, we can expect to see a decline in EPC and capital expenditure costs as the market matures.

The 800 MW Noor Midelt tender (combines both PV and CSP) in Morocco, once awarded, will offer some insight into how prices have changed and set a benchmark for future tenders. It should be noted though, that the tariffs achieved by CSP tenders will depend on factors such as local direct normal irradiance, land costs, local content requirements, interest rates, etc.



## 6. ELECTRIC VEHICLES

According to Bloomberg New Energy Finance, global EV sales are expected to have crossed 4 million in August 2018. As of H1 2018, China emerged as the largest market for EVs, comprising almost 40% of total EV sales (Figure 7). We are now starting to see increased activity and growth prospects for the EVs in the MENA region.



(Source: Global EVRT)

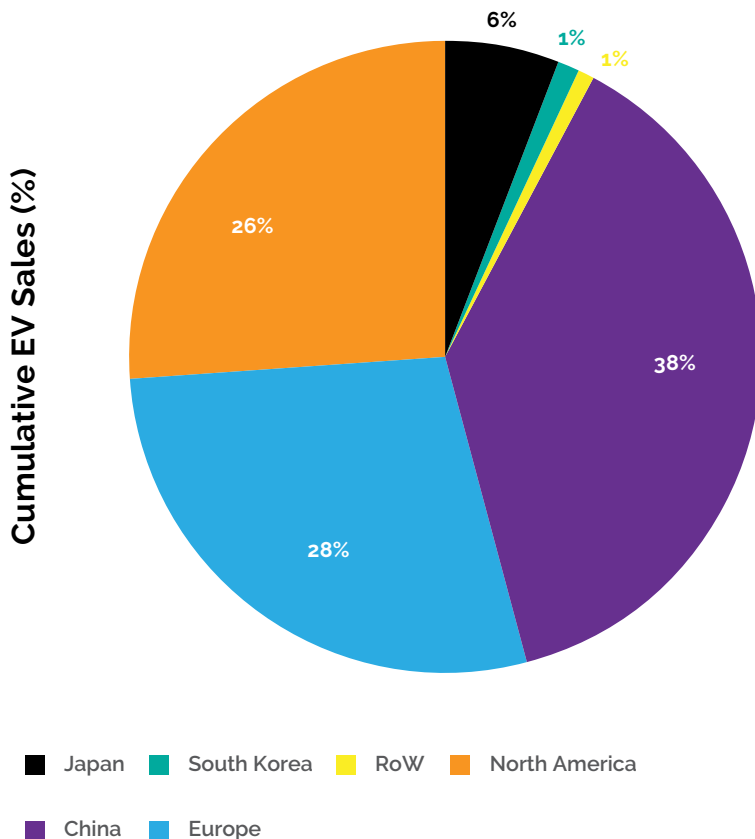


Figure 7: Share of EV Sales, H1 2018 (Source: Bloomberg NEF)

Historically, EV manufacturers have not necessarily viewed the MENA region as a target market, but now manufacturers have or are about to enter. EV adoption is highest in the UAE and Jordan with other markets showing interest. While awareness amongst the general public has increased, there still seems to be an unfamiliarity with the associated costs and benefits.

Also, there is a need to expand charging infrastructure.

People seem to have concerns around insurance and financing costs for EVs, especially as upfront costs of the cars can be higher than for combustible engine cars.

However, the total costs can actually be lower than those for petrol powered cars when compared to the lifespan of an EV, provided the right incentives are in place.

Examples of incentives being offered in regional markets include:

- » **Low interest loans**
- » **Free charging at public charging stations**
- » **Discounted car registration fees and highway toll exemptions**
- » **Little to no import duties**

In Jordan and the UAE, the governments have tried to ease range anxieties by installing more charging stations. DEWA has recently announced that it doubled the number of charging stations in Dubai from 100 to 200. In Jordan, there are plans to install 10,000 charging stations.

In emerging markets like Oman, while the policies and regulations to adopt EVs are still being developed, the first set of charging stations have begun to emerge due to increased interest in EV adoption. The Authority for Electricity Regulation has commissioned a major review of the regulatory preparedness of Oman for electric vehicles to help guide the sultanate's policy direction.

EV costs are expected to drop in the near term as Li-Ion battery prices continue to decline. Since 2010, average battery pack prices have dropped from \$1,000/kWh to \$209/kWh, a decrease by almost 80%<sup>10</sup>. Further price drops are expected but there are concerns around a possible

supply crunch of cobalt, one of the components used in Li-Ion batteries. Should this become an issue over time, we could see a shift in the material make up of EV batteries.

An emerging trend is the use of EV batteries, especially used ones, in storage applications after they've reached their end of life. Batteries can retain 60-70% of the original capacity, so in markets where EV battery makers are required to dispose of or recycle their products, the manufacturers can reduce recycling costs and generate revenue by refurbishing and selling the batteries for further use. An example of this is the 3 MW storage system at the Johan Crujff Arena in Amsterdam, which uses a combination of new and used EV batteries.

EVs have enormous growth potential in MENA markets. While only a handful of countries have regulations or policies in place to support the sector's growth, we can expect the uptake of EVs to increase as regulations develop and private sector involvement increases.



(Source: Global EVRT)

<sup>10</sup> Bloomberg NEF

## 7. HIGHLIGHTS IN MENA'S LEADING SOLAR MARKETS

This section is an overview of the biggest solar markets in the region.

Each country profile briefly summarizes the current energy situation and provides updates on both the utility scale and distributed solar segments, mostly focusing on PV and CSP.

### 7.1 ALGERIA

CLEAN ENERGY TARGET	TARGET YEAR
22 GW (13.6 GW PV, 2 GW CSP)	2030

#### CURRENT SITUATION

Decreased revenues from oil and gas exports (majority of the country's exports) have placed a strain on government coffers. Increased industrial activity is putting pressure on state utility Sonelgaz to increase electricity production. Although investments in oil and gas projects are increasing, there is potential for large scale solar deployment, especially because the government has pledged to support the growing domestic PV manufacturing industry. However, some of the major challenges to deployment are:

1. Access to financing because of the current ban on foreign debt in the country. This means that companies need to resort to internal sources of funding, but local interest rates are high and tenures tend to be short. Foreign debt is allowed for "strategic projects", so DFI financing may be acceptable.
2. Bankability of the PPA, of the off-taker (Sonelgaz) and the government's unwillingness to provide sovereign guarantees. The FIT program, which was also introduced in 2013, has now been repealed, leading the government to introduce a new tender/auction system.

The 4 GW solar tender, which has previously been delayed, is making progress and is almost complete, barring a few sections which are still under review. Sonatrach plans to tender 1.3 GW of projects on an EPC basis to increase solar energy use across its production sites. Solar tenders totaling 200 MW, under the new auction system, were approved in April 2018 and were launched in November 2018:

- 150 MW will be tendered on an IPP auction basis nationally, although foreign and local entities can combine to form a local special purpose vehicle (SPV) in order to bid for the project, while the remaining 50 MW will be deployed in the form of a national EPC tender.

The commercial and industrial (C&I) and residential PV segments within the country have been slow to take off as conventional energy prices have been very low due to government subsidies. Additional incentives are needed for C&I clients to take on solar energy projects, although there have been signs that some industrial customers have expressed interest in solar. The frameworks and policies that help define these segments are not in place yet, but the government is working to provide baseline level of regulation in early 2019.

#### OUTLOOK

Although investment in oil and gas is increasing, the government is encouraging the public to think smart and reduce energy consumption wherever possible. There has been a lack of consistency related to government support schemes, so there needs to be increased transparency with respect to the current regulations in place and improved options for financing to increase investor confidence.



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## 7.2 BAHRAIN

CLEAN ENERGY TARGET	TARGET YEAR
255 MW (PV)	2025
700 MW (Renewables)	2030

### CURRENT SITUATION

Oil and gas still make up much of current consumption and exports but a number of initiatives are being used to reach 255 MW of PV by 2025, as per National Renewable Energy Action Plan (NREAP), namely:

1. Net Metering – enacted in January 2018
2. Tender based FiT scheme – likely to see the rooftops of government buildings tendered in batches, at least for the initial tender rounds
3. Renewable energy and energy efficiency mandates for buildings

The government has been quick to react to its sustainability targets and is actively working to increase solar energy deployment in the country. It has conducted training courses for solar consultants and contractors to ensure adequate quality of future installations. It is working with local banks to encourage them to provide financial support to individuals wanting to install solar plants and is also trying to improve public awareness about solar energy.

So far, activity in the commercial and industrial segment has been greater than the activity in the residential segment, mainly because actors in the C&I space are more aware about the efficiencies solar energy brings.

A major challenge to solar energy deployment at the moment is the limited amount of land available to develop projects. Installing large, ground mounted solar projects will be difficult, so solar projects will be installed mostly on building rooftops, car parks, homes etc.

The country has a small amount of PV manufacturing capabilities through a plant capable of producing about 16 MW. There is around 152 MW of projects either already connected or in the pipeline.

- 52 MW is from smaller, distributed projects
- 100 MW is related to Askar solar IPP issued by the Electricity and Water Authority (EWA) that will be built on a landfill site. A total of 26 companies submitted the Request for Concept (RFC) and 13 were approved for the RFQ. The deadline for bid submissions is 28th November 2018 and the PPA is expected to be signed sometime in Q1 2019.

**OUTLOOK**

Despite the limited land resources available, the government has taken various initiatives to increase solar energy adoption. It seems like most of the capacity additions will come through rooftop installations, especially once adoption amongst the private sector increases. The country is on track to meeting its solar energy targets, so we expect 255 MW, or more, to come online by 2025.

**7.3 EGYPT**

CLEAN ENERGY TARGET	TARGET YEAR
40% total generation	2035

**CURRENT SITUATION**

Egypt has been investing heavily to expand power plant capacity and related infrastructure because of rising electricity demand. In line with economic reforms, energy subsidies are in the process of being phased out completely by 2022. High electricity demand coupled with decreasing subsidies means new generation capacity and grid upgrades are needed quickly.

Construction of solar PV plants in the flagship 1.8 GW Benban complex in Aswan is making progress with completion projected by Q3/Q4 2019. The 200 MW Kom Ombo solar PV and 600 MW West Nile solar PV tenders were the first tenders issued outside of the FIT scheme

- The 200 MW Kom Ombo solar PV tender received a low bid of 2.752 US\$ cent/kWh
- After seeing the low bids come through, the Egyptian Electricity and Transmission Company (EETC) has now set a price ceiling of 2.5 US\$ cent/kWh for the 600 MW West Nile solar PV tender
- A tender for a 100 MW CSP plant in West Nile is currently being developed and should be completed by mid-2019
- EETC is now preparing the framework agreement to start the measurement campaign for the 200 MW solar PV tender in West Nile, for which the pre-qualification documents were originally submitted in 2015

The number of contractors offering solutions for distributed solar PV plants has grown in the past few years. Initial growth has been seen more on the C&I segment than residential, mainly because of limited space on multi-family buildings, capex costs required for solar systems and subsidized electricity. Given the economic reforms the country has implemented, it is understandable that, for most residents, spending money on solar systems is not a top priority at the moment. Another reason for slow growth is that financing options for projects are limited and those that exist offer high interest rates. According to the EETC's Annual Report from 2017, 300 MW of solar PV projects with capacities less than 500 kW were targeted for installation. So far, around 50 – 100 MW of those projects have been connected to the grid.

**OUTLOOK**

After a period of political turmoil and economic reforms, the country has done well to move forward with its renewable energy development goals. As more utility scale projects come online, a major challenge will be ensuring that the grid can handle the influx of these projects, so strengthening grid infrastructure should be a top priority among key stakeholders. It is expected that around a total of 3-4 GW of solar energy will come online in the next 2-3 years (this includes the 1.8 GW Benban complex).

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#### 7.4 JORDAN

CLEAN ENERGY TARGET	TARGET YEAR
10% of total energy mix	2020

#### CURRENT SITUATION

Jordan imports around 95% of its energy, which is why the country has spearheaded renewable energy project development. According to the Ministry of Energy and Mineral Resources, demand for electricity is increasing by 2.5% per year and costs approximately 7% of national GDP. Therefore, additional capacity is needed to meet this demand and reduce government spending in the form of subsidies on electricity. In fact, the country may exceed its targets and generate 22% of its energy from renewables by 2020. While solar projects are increasing in number, grid limitations restrict the ability to handle additional capacity which could temporarily halt the growth of solar projects. As a result, the country has launched some of the first energy storage projects in the region.

The utility scale segment has made significant strides. In September 2018 the results of the Round 3 auction were announced and a low bid of 2.488 US\$ cent/kWh was submitted, more than half of the total price from the Round 2 auction. In April 2018 the country's largest PV plant, the 103 MW Quweira plant, was completed and the 200 MW Baynouna PV project is under construction with completion expected in 2020. In terms of distributed generation, there is about 300 MW of installed systems under the net metering and wheeling schemes.

A 12 MW PV and integrated 12 MWh Li-Ion battery project reached financial close in May 2018 and completion is expected in Q4 2018. An expression of interest (EOI) for a 30 MW/60 MWh energy storage project was released in February 2018. 42 EOIs were received and 25 companies were pre-qualified. Bid submissions are due in December 2018 and the project is meant to go online around Q4 2019.



When it comes to financing these projects, there is some movement from local banks. The lenders have recognized that low interest financing for solar is important and are looking into it on a project by project basis. Local project developers have also started to offer solar leases to help minimize upfront investment by solar adopters. Other financial offerings could help increase adoption for those unable to handle the upfront investment.

**OUTLOOK**

As the solar industry continues to grow, it seems like grid integration issues might be one of the biggest challenges to be addressed.

- The Green Corridor Project, which aims to improve the grid network, is one of the major projects being undertaken to address renewable energy integration.

We can expect to see additional tenders for battery storage and possibly even for utility scale CSP plants. Given how fast solar is growing, we are expecting around 1200 – 1500 MW of solar PV to be connected to the grid by 2020/2021, barring any major grid integration issues.

**7.5 KUWAIT**

CLEAN ENERGY TARGET	TARGET YEAR
15% of total energy mix (~4.5 GW)	2030

**CURRENT SITUATION**

Kuwait's economy has felt the effects of recent oil price fluctuations and has therefore committed to diversifying its energy sector and adding renewable energy to the electricity generation mix. Historically, solar projects were being funded more for research purposes by the Kuwait Institute of Research. Recently though, the Kuwait Foundation for the Advancement of Sciences (KFAS) started funding projects for commercial use.

In June 2018, the Kuwait National Petroleum Company (KNPC) announced 17 prequalified companies for its first utility scale solar project, the 1.5 GW Al Dibdibah solar PV power plant.

- Due to some delays in the prequalification process, it appears the project will be awarded in Q1/Q2 2019. KNPC floated a tender for supply, construction, operation and maintenance of the plant in September 2018.

The 280 MW Al Abdaliyah integrated solar combined cycle (ISCC) plant, which was supposed to have a 60 MW solar PV component, has been on and off for eight years and was retendered in 2017. There have been no major developments since the retendering.

Presently, there is about 24 MW of installed PV capacity but no net metering scheme or FiT policy in place. There is interest in small scale solar projects but the tenders and executed projects are progressing much slower than expected. The reasons for this are:

- The lack of experience amongst some approved engineering consultants who seem to lack the technical know-how of designing good PV systems to effectively serve client needs. The market for residential solar is small, with some special projects carried out by sponsors.
- The industrial segment in Kuwait still enjoys high electricity tariff subsidies, so there is little room for solar to drastically reduce costs. Although the electricity tariffs have increased over time, it is still not high enough to make solar energy an attractive alternative..

KFAS has been pushing homeowners to install rooftop solar by offering to finance projects, provided that the homeowners pay an initial insurance fee. The organization targeted 1500 homes so we can expect around 10 MW of rooftop projects to come out of this initiative. We can also expect an increase in the number of solar plants within the public/governmental organizations over the next five years.

**OUTLOOK**

The solar industry in the country is starting to grow but there needs to be clear regulations supporting the growth of the industry, especially in the distributed generation segment, and an adequate capital allocation to ensure the successful implementation of these regulations. Based on the projects currently underway, we can expect around 1.6 GW of PV to come online within the next two to three years.

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## 7.6 MOROCCO

CLEAN ENERGY TARGET	TARGET YEAR
2 GW (Solar)	2020
5 GW (Solar)	2030

### CURRENT SITUATION

Morocco has historically been an energy importer due to a lack of natural resources. The cost of electricity in the country is set to rise given the recoveries in oil prices and progressive removal of electricity subsidies. Like in other MENA countries, Morocco needs additional investment in grid infrastructure, which is why the European Bank for Reconstruction and Development (EBRD) recently issued a tender to seek out consultants to help evaluate the ability of the grid to absorb more renewables.

Under the current institutional framework, solar projects are developed in three different ways:

1. Private solar projects, which are developed under commercial PPAs by private developers
2. Projects developed by the Moroccan Agency for Sustainable Energy (MASEN), an agency created to help increase the development of renewable energy projects
3. Projects developed by the state utility, Office National de l'Electricité et de l'Eau Potable (ONEE)

In addition to solar PV, Morocco has been one of the few countries to adopt multiple CSP projects.

- The 580 MW Nour Ouarzazate complex, which should be fully operational in early 2019, will become one of the largest CSP plants in the world
  - The second, 200 MW and third, 150 MW phases of the plant should be completed by the end of 2018 or early 2019
  - The fourth phase, a 70 MW PV plant, is expected to reach completion by the end of 2018
- Under the Nour PV 1 scheme, the Nour Laâyoune and Nour Boujdour PV plants, with capacities of 80 MW and 20 MW respectively, are scheduled for completion towards the end of 2018
- Two bidders are currently competing for the hybrid (PV and CSP) 800 MW Nour Midelt project; the first phase of which will consist of a 150-190 MW CSP component with five hours of storage

Masen announced the 800 MW Nour Tata project, although further details are yet to be revealed. ONEE has also launched a solar program, calling for the development of 500 MW of PV capacity by 2020.

PROJECT	POWER PLANT	TECHNOLOGY	YEAR COMMISSIONED	CAPACITY (MW)
NOUR OUARZAZATE COMPLEX	Nour Ouarzazate I	CSP - Parabolic Trough	2016	160
	Nour Ouarzazate II	CSP - Parabolic Trough	2018	200
	Nour Ouarzazate III	CSP - Tower	2018	150
	Nour Ouarzazate IV	PV	2018	70



<b>NOOR PV 1</b>	Noor Laâyoune I	PV	2018	85
	Noor Boujdour I	PV	2018	20
<b>NOOR TAFILALET</b>	Noor Missouri	PV	2018	40
	Noor Erfoud	PV	2018	40
	Noor Zagora	PV	2018	40

Table 3: Status of major PV and CSP projects in Morocco (Source: MASEN)

The Tata project will be split into three phases called Tafilalet, Atlas and Argana. The status of each is as follows:

- Noor Tafilalet: 120 MW project was split into three separate projects of 40 MW each in Arfoud, Missouri and Zagora. Each of these three projects were scheduled to be commissioned towards the end of 2018.
- Noor Atlas: planned to have a total capacity of 200 MW over eight installations ranging from 10 – 30 MW each.
- Noor Argana: planned capacity of this project was 200 – 225 MW; pre-qualification was expected to commence at the beginning of 2017, though a list of bidders has yet to be announced.

The distributed generation segment in the country is small but developing. At present, the actual applicable legal framework does not enable developing private solar projects though a draft decree is still being discussed. This type of framework should be further developed to ensure opportunities exist for small scale project developers.

## OUTLOOK

As the utility scale segment becomes more established, the distributed generation segment is still in its early stages and the applicable laws surrounding private/corporate PPAs need to be developed and finalized to ensure growth in this segment. The country's renewable energy strategy outlines an estimated \$9 billion investment to install 2 GW of solar by 2020, so we can expect additional IPP tenders by ONEE and MASEN in the next couple of years, if the 2 GW target is to be met.

## 7.7 OMAN

CLEAN ENERGY TARGET	TARGET YEAR
10% of total energy mix (~2.6 GW)	2025

## CURRENT SITUATION

The Sultanate of Oman has oil and natural gas reserves. However, similar to other GCC countries, it is moving towards diversifying its energy mix. Although oil price declines in the last few years are partly responsible for this shift, the country has been trying to push renewable energy development since 2008. Yet a lack of policies and uncompetitive prices posed obstacles. Around 70% of government revenue is derived from oil and gas exports. The recent decline in revenue coupled with projected increases in electricity demand is why the country is seeking alternative solutions. The Oman Power and Water Procurement Company (OPWP) plans to procure 2.6 GW of renewable energy projects between 2018 – 2024.

Some updates on utility scale projects:

- Tender for Ibri 500 MW solar PV plant was due at the end of October 2018. A total of 12 firms were pre-qualified and the project is expected to be awarded by early 2019 and become operational in 2021.

- PDO awarded the 100 MW Amin PV project in October 2018 under a 23-year PPA.
- In October 2018, OPWP issued an RFP for technical consultancy services for the development of the Solar 2022 IPP. The capacity of this project will be between 500 MW – 1000 MW and expected to come online in 2022.
- There are plans to release two more tenders of 500 MW (or larger), Solar 2023 IPP and Solar 2024 IPP. These four projects are expected to be completed between 2021 – 2024, one per year.
- The 1 GW Miraah concentrated solar power plant, being used to generate steam for enhanced oil recovery (EOR) processes, was inaugurated in February 2018. The plant is partially completed with the first four blocks of 36 blocks currently delivering 100 MWt of steam.
- 1 GW of solar PV is also being planned at the Sohar Port

There is currently an RFP out for technical advisory services of phase 2 of the Sahim scheme. Sahim is not a net metering scheme but allows consumers to sell power back to the grid at the prevailing bulk electricity tariff. This phase aims to support the wide-scale deployment of residential PV systems (3 kW – 5 kW) by tendering rooftops of residential buildings to private developers who will contract with the relevant distribution companies. The costs of procuring, constructing and maintaining PV systems under Sahim 2 will not be met by customers, but by private sector entities that will recover costs via contracts with licensed suppliers.

There is currently about 15-20 MW of rooftop projects in the pipeline, with only a handful of projects connected. While it took time to develop the market after Sahim Phase 1 was announced, there has been solid interest in solar PV, especially from the C&I customers facing higher tariffs and from government entities. Despite growing interest in solar, there are some challenges that need to be addressed:

- Subsidized electricity tariffs are one of the main hurdles facing growth in the distributed generation segment. If further subsidy reform is not introduced, there is little incentive to install solar PV systems
- Offer adequate training to solar contractors, at least during the early years of Sahim, to ensure that all PV systems being installed abide by the highest quality standards.

## OUTLOOK

Even though solar energy development is at a nascent stage, the removal of subsidies for heavy energy consumers, mandates for the four large scale solar projects and introduction of the Sahim schemes are all steps in the right direction. Once the first of the four utility scale solar plants comes online and the Sahim scheme grabs the attention of private developers, we can expect increased confidence and growth in the country's solar sector.

## 7.8 PAKISTAN

### CURRENT SITUATION

Energy demand in Pakistan has increased by over 5%<sup>11</sup> in recent years but the country still suffers from power outages because of unsuitable grid infrastructure, plant downtimes, load shedding etc. About 27%<sup>12</sup> of the population still lacks access to electricity. The government responded by implementing policies to help increase supply of clean energy to the generation mix and reduce subsidy expenditures. Unreliable grid supply, inadequate grid infrastructure and rising electricity prices are helping solidify the case for solar energy deployment. The presence of a huge off grid market also presents an opportunity for small solar kits for rural areas because many imports specific to solar are targeted at these rural regions.

According to the Alternative Energy Development Board (AEDB), the current status of solar projects is as follows:

- 23 solar projects totaling 892.52 MW are at different stages of development
  - There are six solar projects totaling 430 MW in operation
  - Four projects totaling 41.52 MW are nearing financial close
  - 16 solar projects totaling 421 MW are at different stages of development are expected to be completed by 2019/2020
- As of November 2018, approximately 700 customers have been issued generation licenses for a total of 15 MW under net metering
  - Around 3-4 GW of net metering installations are targeted over the next three to four years

<sup>11</sup>IRENA

<sup>12</sup>IRENA



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It is expected that almost 1.2 GW of PV will be procured through competitive bidding by 2021 via auctions at the Quaid Azam solar park and other locations. The IFC's Sindh Solar Energy Project is helping procure 400 MW of utility scale projects through competitive bidding, 20 MW of distributed solar on public buildings and 200,000 solar home systems.

Net metering was first introduced in 2015, but was revised in January 2018 to streamline the process for receiving approvals for grid connection to help reduce installation time. Most consumers applying for net metering are high-paying industrial/commercial customers but domestic consumers have also shown interest in solar because of the cost savings it can provide.

According to IRENA's Renewable Readiness Assessment, net metering regulation should consider the growing concerns of the various distribution companies regarding their financial liquidity. Regulation also remains a grey area because the National Electric Power Regulatory Authority (NEPRA) has the mandate to regulate the market, but not to define the policy frameworks and incentives. This places a gap to achieving a comprehensive distributed energy plan.

Some of the challenges facing the distributed generation segment:

1. There has been some support from banks to help subsidize costs of installing solar plants but generally, financiers have been slow to adopt solar financing
2. There is limited standardization or quality control measures for imported products
3. Solar vendors are focused only on sales and not on providing complete end to end solutions

**OUTLOOK**

Echoing the findings from IRENA's Renewable Readiness Assessment, there needs to be an integrated energy plan that sets targets at the national and provincial level, covering utility and distributed generation solar projects. Encouraging auctions at specifically designated zones, a process that has worked well in other countries, would be a good way to increase solar energy IPP's into the country. Increased investment in grid infrastructure is also necessary to help increase penetration and help almost one third of the population gain access to electricity. If the availability of financing options improves, the distributed generation segment should be able to grow steadily as it has over the past couple of years.

**7.9 SAUDI ARABIA**

CLEAN ENERGY TARGET	TARGET YEAR
9.5 GW	2023

**CURRENT SITUATION**

The Renewable Energy Project Development Office (REPDO) was setup in 2017 as the major governmental body responsible for pushing the renewables industry forward to help meet the 9.5 GW target by 2023, set by the Ministry of Energy. While electricity prices have historically been highly subsidized, they have been rising over the past year to help combat the effects of fluctuating/declining oil prices and increasing government spending.

Renewable energy can now, more than ever, act as an alternative electricity source to consumers wishing to hedge against rising electricity tariffs. In line with the Vision 2030 to help the economy flourish and create ample job opportunities, the country is trying to establish a local PV panel manufacturing presence, whether it be through foreign manufacturers setting up shop locally or by supporting the emergence of locally built module manufacturers.

Some utility scale project updates:

- In February 2018, the country's first utility scale PV project, the 300 MW Sakaka plant, was awarded at a price of 2.34 US cents/kWh and achieved financial close in November, 2018. The Sakaka project had a 30% local content requirement, a number that REPDO could increase in future tenders. However, balancing high local content requirements with the low tariffs could prove to be a challenge, especially once we start to see larger projects being tendered.
- Duba 1 Integrated Solar Combined Cycle (ISCC) plant is currently under construction and is expected to be ready by 2019; the plant will have a 50 MW CSP component.

- The 1390 MW Waad Al Shamal ISCC plant was commissioned in July 2018 and has a 50 MW CSP component.

In August 2017, the Electricity and Cogeneration Authority (ECRA) approved a net metering scheme for projects up to 2 MW in size. However, the 2 MW cap was imposed to help ensure grid stability. The net metering regulation will be fully implemented either at the end of 2018 or beginning of 2019.

The C&I segment is slowly growing though financing options for corporate PPAs are still largely unavailable. However, the 30 MW National Agricultural Development Company (NADEC) solar project that was recently awarded achieved a low bid of 2.42 US\$ cent/kWh, proving that there is potential in the C&I segment, especially as state subsidies continue to be removed. Residential PV is not cost competitive with current utility prices, except for some heavy energy consumers. There is also little understanding among the population about the cost of solar, despite widespread interest in PV at the residential scale.

## OUTLOOK

2018 was a milestone year for solar in the country because of the introduction of net metering and the awarding (and financial close) of the first utility scale solar project. 3.45 GW of renewable energy are targeted by 2020, so we should expect to see a lot of activity in 2019 on the project development/construction front if the target is to be met. Once solar energy can offer competitive LCOE's and the local manufacturing industry becomes more established, the kingdom has the potential to become a major regional hub for solar energy.



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## 7.10 TUNISIA

CLEAN ENERGY TARGET	TARGET YEAR
30% total generation (~4.7 GW)	2030

### CURRENT SITUATION

The Tunisian solar market has been among the first ones to issue renewable energy incentives and laws (since 2009, renewable energy projects for "auto consumption" were allowed by Tunisian law). The market did not grow fast enough and the policies did not follow the pace of other MENA countries to allow for the launch of major utility scale renewable energy projects. However, the market has become more promising in recent years. The Tunisian Solar Plan is aiming for 1 GW of solar capacity by 2020 and an additional 1.25 GW of renewable capacity by 2025. So far, the country has relied on auctions instead of a FiT mechanism, which have been working up until now. However, some auctions have seen delays.

The country has a small, but vibrant local industry in PV manufacturing and in installation of small, residential systems. Therefore, as projects increase in size and number, we can expect to see additional manufacturing capacity which will lead to further job opportunities.

Challenges facing the industry include:

1. Access to financing: an issue because the government has not committed to providing sovereign guarantees (at least for the authorization regime) and local borrowing is expensive
2. PPA Bankability: The template issued by the ministry in February 2017 (under the authorization regime) was revised in September 2018. Provisions were made to certain sections, including changes in the law, termination and arbitration but lack of sovereign guarantees and of compensation measures for Force Majeur are a couple of the provisions that have yet to be updated but should be considered.

Capacity thresholds for solar PV projects under the authorization regime are 10 MW. The results of the first authorization scheme were announced in May 2018. Six 10 MW solar plants and four 1 MW ground mounted PV plants were awarded. Most of the winners consisted of local developers, with a couple of international developers (from France and Italy).

Following this announcement, a call for pre-qualification for deployment of 500 MW of solar PV and 500 MW of wind farms was announced under the tender process. In November 2018, 16 entities were pre-qualified for the solar tender which covers five projects across the following governorates:

1. 50 MW in Tozeur
2. 50 MW in Sidi Bouzid
3. 100 MW in Kairouan
4. 100 MW in Gafsa
5. 200 MW in Tataouine

A second round of the PV auctions (70 MW) originally due on August 15th, 2018 has now been pushed back four months to December 18th, 2018. The second round will consist of six 10 MW projects and ten 1 MW projects. Under the current regime, the Tunisian government will not provide project sites to sponsors, so developers must lease or purchase the land they intend to use.

In September 2018 the Tunisian National Agency for Energy Conservation (ANME) announced it is planning a 1.7 GW solar park in three phases:

- Phase 1: Implement 200 MW between 2018 and 2020
- Phase 2: Implement 500 MW between 2021 – 2025
- Phase 3: Implement 1 GW of solar capacity

The C&I segment has been especially promising because of initiatives to promote growth in distributed generation but conventional energy prices are still very low due to government subsidies. There are also installers of small/residential systems but the number of projects installed is limited.

## OUTLOOK

The Tunisian government is ambitiously pursuing the development of renewable energy projects but issues remain around the bankability of the PPA (under the authorization regime), at least from international investor's point of view. Once the PPA is deemed bankable, then international investment in solar projects should increase, especially once projects in the initial auction/tender rounds reach financial close.

### 7.11 UNITED ARAB EMIRATES

CLEAN ENERGY TARGET	TARGET YEAR
50% total generation	2050

## CURRENT SITUATION

With the aim of diversifying its energy mix, the UAE has been one of the early adopters of solar energy in the region. Most current energy consumption is met through natural gas but the national strategy is to generate 50% of total energy from clean sources by 2050. Dubai has had a net metering policy, called Shams Dubai, in place since 2015 and is currently developing its flagship project, the 5 GW Mohammed bin Rashid Al Maktoum Solar park. Abu Dhabi also has a net metering policy in place implemented in late-2017.

The 5 GW solar park in Dubai is making progress (Table 4), with 213 MW from the first two phases already completed. The first 200 MW from the 800 MW third phase was inaugurated in May 2018.

- The second and third stage of the third phase will consist of two 300 MW plants which are scheduled to be completed by 2019 and 2020 respectively

PHASE	CAPACITY	STATUS
Phase 1	13 MW	Operational
Phase 2	200 MW	Operational
Phase 3 – Stage 1	200 MW	Operational
Phase 3 – Stage 2	300 MW	Construction
Phase 3 – Stage 3	300 MW	Construction
Phase 4	950 MW	Awarded
Phase 5	300 MW	Announced

Table 4: Different phases of 5 GW Mohamad bin Rashid solar Park (Source: MESIA)

- The first stage of the fourth phase 700 MW CSP plant was awarded at a tariff of 7.3 US\$ cent/kWh in 2017. A first amendment was made to the PPA, allowing for an additional 250 MW of PV to be added, leading to a total installed capacity of 950 MW. The project has not yet reached financial close.
- The 1.17 GW Sweihan solar PV plant in Abu Dhabi is currently under construction and is expected to come online in Q1/Q2 2019.
  - A tender for the Sweihan II plant, expected to be around 1.5 GW, is also expected to be floated in early 2019
- DEWA is looking to launch an EOI for Phase V of the solar park, a 300 MW CSP plant





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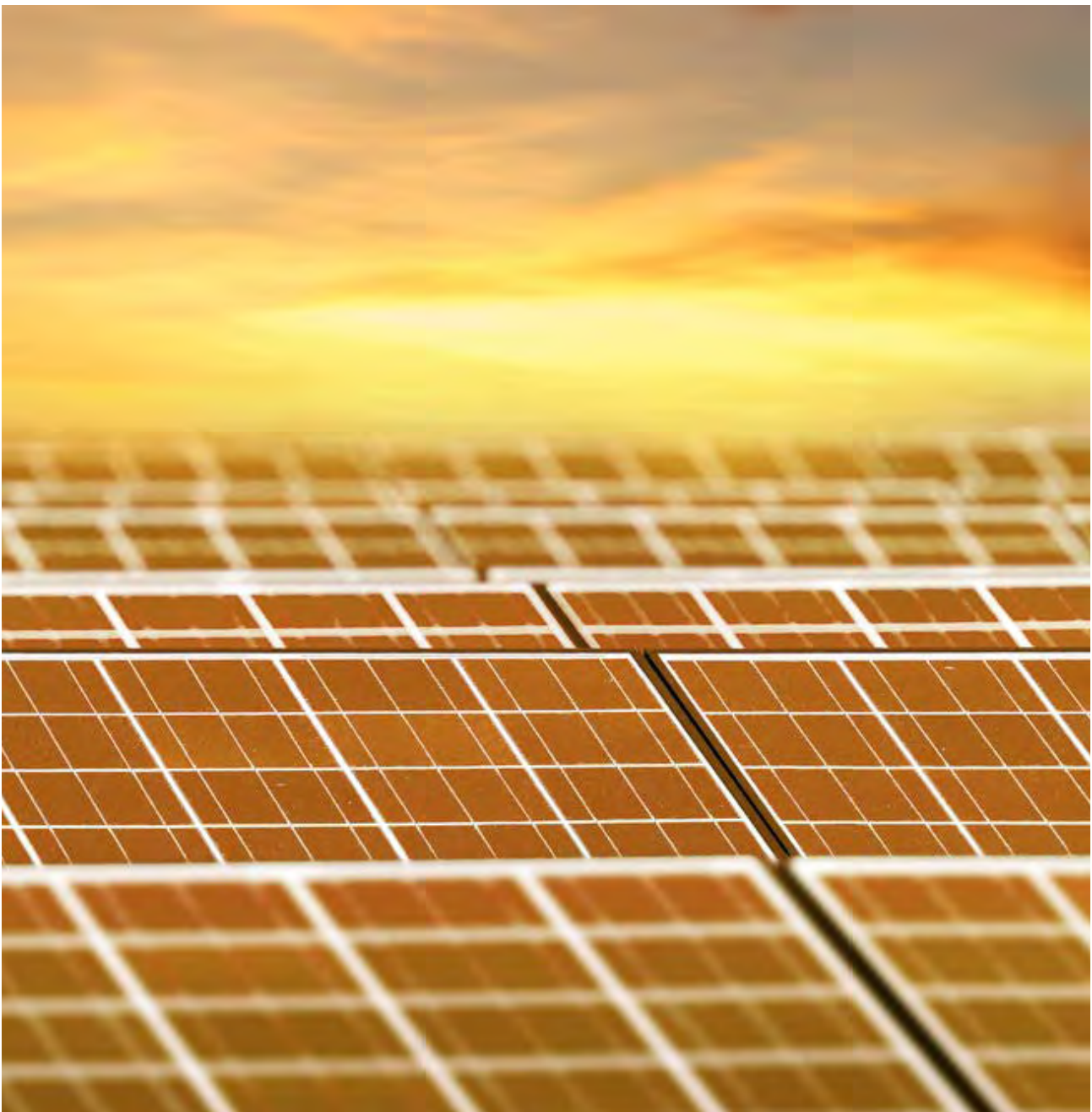
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The Shams Dubai program has been the main driver for distributed generation growth in the UAE. There is about 50 MW of net metered systems currently operating with close to 35 MW of this capacity coming online in the last 12 months. There are requests to connect an additional 323 MW so we can expect significant activity in the distributed segment over the next few years, especially once the market opens up in other emirates. Most of the uptake has been seen from the C&I space, while residential adoption has been slow to progress. The lack of financing can be a major constraint in many regional markets, but the emergence of private developers offering solar leases is a growing trend in the UAE.

## OUTLOOK

The solar market in the UAE has become one of the fastest growing in the region. The growth in both the distributed generation and utility scale segments showcase the government's commitment to its renewable energy goals. While no utility scale tenders, outside the upcoming ones in the 5 GW solar park and Sweihan II, have been announced just yet, we expect significant growth in the distributed generation segment.





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In 2017 Fronius was confronted with an issue concerning the evaluation of harmonic emissions induced into the public distribution network in Dubai. A PV system showed behavior which was not accepted by the DEWA (Dubai Energy and Water Authority). Since Fronius had not encountered this particular behavior before, experts from Fronius International conducted an on-site visit of the affected PV system.

It soon became clear that the issue was not caused by Fronius inverters, yet Fronius continued the investigation to find the issue's root cause and found out that the measuring equipment had a software bug. By updating the equipment, the issue was resolved and the correct measurement was in line with DEWA criteria. Although not liable, Fronius International provided full support and played a key role in getting the PV system approved by DEWA.

*„SirajPower, the UAE's largest distributed solar energy producer, has been using Fronius inverters in many of its projects. Fronius inverters are easy to install and maintain. Their modular technology makes it more convenient to deal with the service issues.“*

Laurent Longuet, Director SirajPower



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## 8. CONCLUSION

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The outlook for solar energy in the region remains bright. We're expecting to see growth in all segments of the industry if governments remain committed to achieving their renewable energy targets. Even though solar PV has been the dominant technology in terms of deployment, CSP and PV plus storage are proving to be cost competitive technologies/ solutions that are expected to proliferate the market in the near-term.

Distributed generation solutions will continue to grow as they have in the last few years, but regulation is still lacking in many markets. Subsidy reform is a major factor that influences how competitive solar can be to conventional technologies, so the appropriate policies to phase out subsidies need to be enforced. Simply implementing energy management policies like net metering and wheeling is not enough to promote growth. Options for financing small scale solar projects will become more innovative and provide greater access to the potential solar customer base. We expect increased investment from private and commercial banks once they realize the returns they can achieve by investing in solar assets. Use of EVs is growing quickly and will become a major factor in influencing the storage market, mostly because of the second-life use cases of Li-Ion batteries used in the cars.

We are confident in the growth prospects for solar energy and are excited to see how the MENA market evolves to hopefully become one of the fastest growing in the foreseeable future.

## 9. CONTACTS

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## 10. GLOSSARY OF TERMS

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AEDB	Alternative Energy Development Board
BESS	Battery Energy Storage System
BIPV	Building Integrated Photovoltaics
BOS	Balance of System
C&I	Commercial & Industrial
CSP	Concentrated Solar Power
DEWA	Dubai Electricity and Water Authority
DFI	Development Finance Institution
EBRD	European Bank for Reconstruction and Development
ECRA	Electricity and Cogeneration Regulatory Authority
EETC	Egyptian Electricity Transmission Company
EMS	Energy Management Software
EOI	Expression of Interest
EOR	Enhanced Oil Recovery
EPC	Engineering, Procurement & Construction
EV	Electric Vehicle
EWA	Electricity and Water Authority
FiT	Feed-in Tariff
GCC	Gulf Cooperation Council
GDP	Gross Domestic Product
GW	Gigawatt
IFC	International Finance Corporation
IPP	Independent Power Project

IRENA	International Renewable Energy Agency
IRR	Internal Rate of Return
ISCC	Integrated Solar Combined Cycle
KFAS	Kuwait Foundation for the Advancement of Sciences
KNPC	Kuwait National Petroleum Company
LCEC	Lebanon Center for Energy Conservation
LCOE	Levelized Cost of Electricity
LNG	Liquefied Natural Gas
MASEN	Moroccan Agency for Solar Energy
MEMR	Ministry of Energy and Mineral Resources
MENA	Middle East and North Africa
MW	Megawatt
NADEC	National Agricultural Development Company
NEPRA	National Electric Power Regulatory Authority
NREAP	National Renewable Energy Action Plan
ONEE	Office National de l'Electricité et de l'Eau
OPWP	Oman Power and Water Procurement Company
PDO	Petroleum Development Oman
PERC	Passivated Emitter Rear Cell
PERT	Passivated Emitter Rear Totally Diffused
PPA	Power Purchase Agreement
PV	Photovoltaics
REPDO	Renewable Energy Project Development Office
RFC	Request for Concept
RFP	Request for Proposal
RFQ	Request for Qualification
SPV	Special Purpose Vehicle

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