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Dubai Electricity & Water Authority

From Risk to Resilience

Adapting to a changing climate

Climate action for sustainable economic growth

National governments and business leaders have recognised the risk from climate change and how this could affect their assets, operations, and growth ambitions. In recent years, there has been an increase in extreme weather-related events that have caused damage and disruption to communities, business, and infrastructure in many regions of the world. With this trend set to continue, it is time for some critical thinking, and action to protect businesses and organisations from climate risk, especially as they increase activity to meet future carbon targets.

The International Energy Agency (IEA) suggests that solar energy could generate up to 27% of the world's electricity by 2050. Over the same period, climate predictions show an increasing frequency and intensity of extreme weather events in many geographies. Therefore, it is imperative to consider how large-scale renewable energy sites can be protected from potential climate impacts. Strategic and robust adaptation plans are a critical consideration for ensuring these sites are resilient to future risks. Failure to do so could result in losses, costly upgrades or reconfigurations, and interruption of net-zero efforts.

This is particularly pertinent for the Middle East region. As the first Middle Eastern country to announce its net zero plans, the UAE has set an ambitious agenda for climate action. The UAE National Climate Action Plan (2017 - 2050) and the recently updated UAE Energy Strategy 2050 are key pillars of the country's climate strategy.

The UAE National Climate Action Plan cites climate adaptation capacity as one of its primary objectives. UAE and the surrounding region are likely to experience sea level rise, extreme heat conditions, and increasing frequency of storm events, due to the impact of climate change. The UAE Climate Action Plan recognises the need for climate resilience to mitigate current and future risks and emphasises the need for intervention at a 'local' level, as well as a national program of development based upon good data and research.

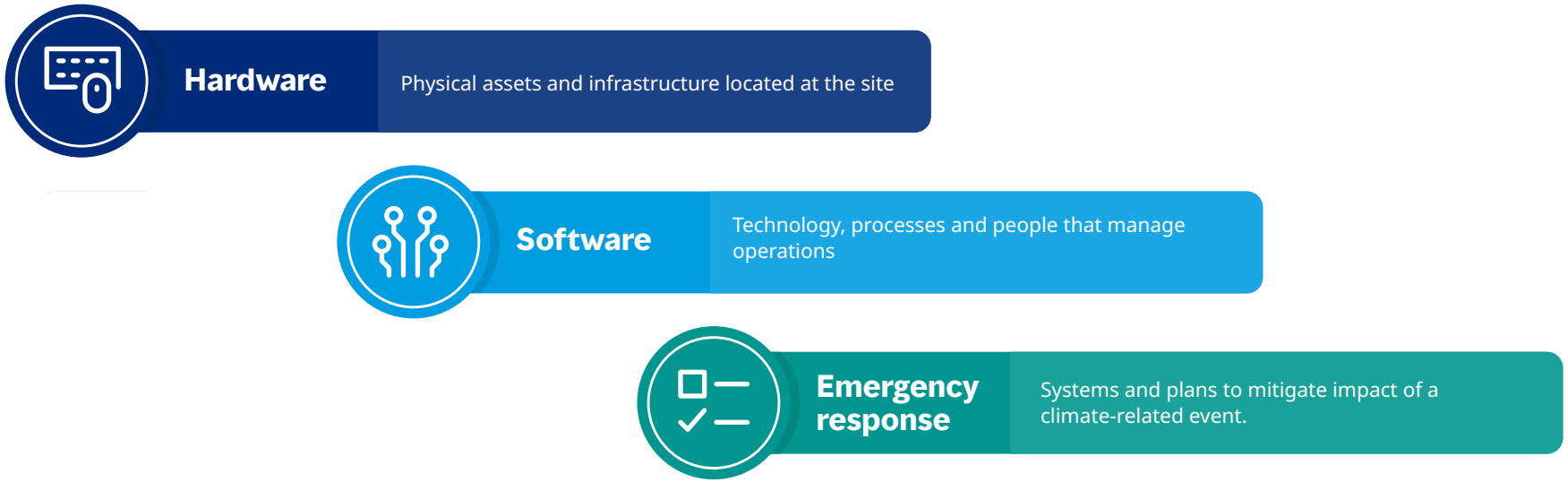
A key enabler to the achievement of the UAE's net zero climate objectives is Dubai Electricity and Water Authority (DEWA PJSC), a world leading utility company which is anticipating and shaping the future of energy using innovative disruptive technologies in the production, transmission and distribution of electricity and water for the Emirate of Dubai, UAE. DEWA is the sole provider of electricity and water for the Emirate of Dubai.

Sustainability lies in the heart of DEWA and is evident in their business and operations. This commitment to sustainability ensures the health and wellbeing of all stakeholders is maintained through continuously embedding best practices into day-to-day operations. DEWA has been committed to providing sustainable electricity and water to the Emirate of Dubai since 1992, adhering to the highest international standards.

From theory to practice – Climate resilience and adaptation

The impacts of climate change will become more pronounced in the coming decades. This can result in damage and interruption to organisations and their assets. It is important for all organisations to identify their climate risk profile, assess their current levels of resilience to those risks, and make plans for adaptation to ensure long-term success. Consequently, developing climate adaptation should be considered as a key ingredient of a sustainable business strategy. DEWA have embraced this concept and have already demonstrated their action in relation to climate resilience and adaptation.

Developing a practical approach needs to recognise local circumstances as well as wider regional, national, and even global trends that may impact a site or an asset. When planning the development of specific assets, we at Marsh recommend considering resilience and adaptation should be considered across three dimensions:



A three-step approach can be used to assess each of these dimensions:

Climate risk identification 01

Using established climate models, climate risk at the site is assessed.

This identifies climate risks that could present at the location over an extended timescale.

The risk is also assessed across different climate warming scenarios.

An 'In-person' survey is undertaken to identify the features of the site, its operation, and existing levels of climate resilience.

Climate impact assessment 02

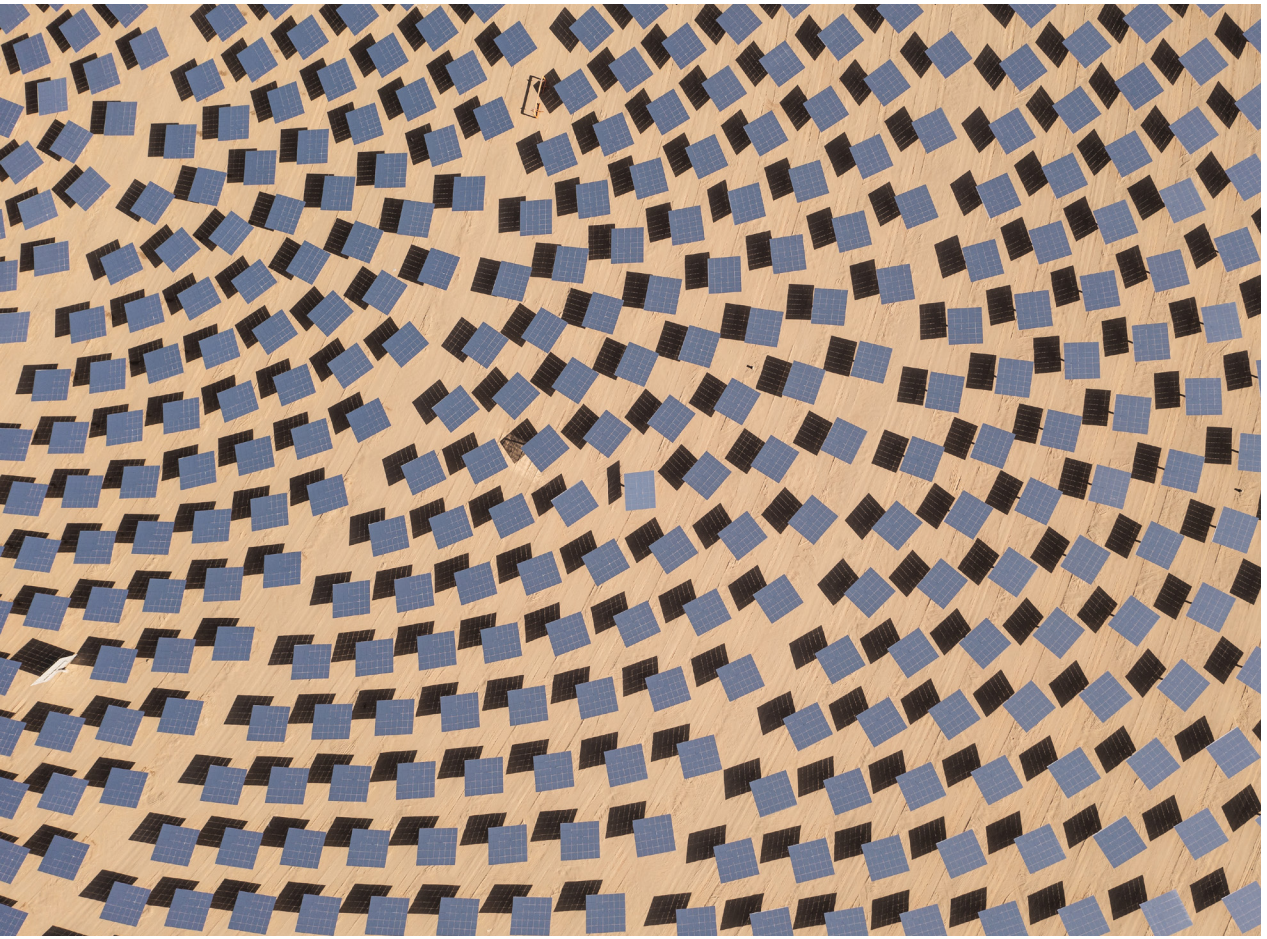
Referencing the climate modelling output and findings from the site survey, the impact on climate at the site is assessed.

This considers climate change predictions and the potential damage and disruption that could occur over different time frames.

To supplement the climate impact assessment, a review of management procedures related to climate risk, emergency response plans, and records of weather-driven events is undertaken.

Climate adaptation recommendation 03

Considering the climate risk in light of any existing resilience measures in place, recommendations for further resilience measures are provided along with the recommended timing to offset future risk.



Case study

THE MOHAMMED BIN RASHID AL MAKTOUM SOLAR PARK

DEWA supports the UAE's efforts to meet its global responsibility to combat climate change, committing to provide 100% of energy from clean energy sources by 2050. The Mohammed bin Rashid Al Maktoum Solar Park is one of DEWA's key projects to achieve this goal. The Solar Park is the largest single-site solar park in the world with a planned capacity of 5,000MW by 2030 and investments up to AED 50 billion. When completed, the Solar Park will avoid over 6.5 million tonnes of carbon emissions annually. The full DEWA Sustainability Report 2022, can be found here.

DEWA, working collaboratively with Marsh, undertook a review of climate risk and resilience at the Mohammed bin Rashid Al Maktoum Solar Park which is the largest single-site solar park in the world, using the Independent Power Producer (IPP) model. It will have a production capacity of 5,000MW by 2030 with a total investment of AED 50 billion. Upon its completion, the Solar Park will avoid more than 6.5 million tonnes of carbon emissions annually. The total capacity of the solar energy projects commissioned at the solar park has reached 2,627MW as of November 2023, from photovoltaic (PV) solar panels and Concentrated Solar Power (CSP).

As the solar park plays an important role in the UAE achieving its net-zero 2050 target, DEWA is assessing the risks from climate change that could affect the solar park, today and in the coming decades. This assessment will consider the current levels of climate resilience at the solar park and identify adaptation options that will provide long-term operational safety.

This report describes how the three-step approach to climate risk and adaptation was applied to the Mohammed bin Rashid Al Maktoum Solar Park.

Step 1: Climate risk identification risk at the Mohammed bin Rashid Al Maktoum Solar Park

The first step in identifying climate risk at the Mohammed bin Rashid Al Maktoum Solar Park was to gather all relevant information on the site. To complete this task, a number of information sources were used (for example, aerial and satellite maps, LIDAR information, and terrain and climate information).

Climate modelling of DEWA's Mohammed bin Rashid Al Maktoum Solar Park site was undertaken to predict climate risk in decadal timesteps to 2100 and using two climate scenarios (Representative Concentration Pathway) RCP 2.5 and RCP 8.5 – the detail of which is shown opposite.

Modelling output predicted a moderate surface water flood risk and the risk of overland flooding from the adjacent access road. The flood risk is predicted to remain stable until 2050 but will increase sharply towards 2100 as the frequency and intensity of rainfall events in the region increase due to climate change.

Extreme heat in the region will also present risk to personnel and operations, reaching dangerous levels from 2070 onwards. Wind loading at the location was predicted to remain stable. Figure 1 illustrates how the climate risk profile changes at the Mohammed bin Rashid Al Maktoum Solar Park from the current day to 2100.

Scenario	Description
RCP8.5 High-end emissions scenario	• Worst-case scenario as emissions continue to rise throughout the 21st century • Delivers an estimated global average temperature increase of ~5°C above pre-industrial levels by 2100
RCP2.6 Stringent mitigation scenario	• GHG emissions are reduced substantially over time • Delivers an estimated global average temperature increase of <2°C above pre-industrial levels by 2100

Representitve concentration pathways

01| Climate risk profile for the Mohammed bin Rashid Al Maktoum Solar Park – current day to 2100 and showing growth trend

	Current day	2050	2100
Predicted surface water flood risk[1]	Min: 0.14m Max: 1.0m	Min: 0.17m Max: 1.2m	Min: 0.5m Max: 2.5m
Predicted riverine (overland) flood risk[1]	Min: 0.0m Max: 1.0m	Min: 0.0m Max: 1.2m	Min: 0.5m Max: 4.2m
Predicted extreme heat risk[2]	48.5 °C	51.0 °C	55.0 °C
Predicted extreme wind risk[3]	83km/hr	85km/hr	89km/hr

1 Based on a 1-in-100 year flood event between 2020 and 2100 under RCP 8.5 scenario.

2 Temperature of a 1-in-20 year extreme heat event under RCP 8.5.

3 Maximum wind speed reached (for a second gust) in different return periods in RCP 8.5. Although average wind risk remains reasonable constant, widstorm events are predicted to increase in frequency.

Step 2: Climate impact at the Mohammed bin Rashid Al Maktoum Solar Park

Once climate risks were identified and their changing profile over time and climate scenarios known, the impact of these risks on the site were assessed. This assessment reflected the magnitude of the risk and how this presents to the site, how much damage or disruption could be caused, and how prepared DEWA was to deal with these risks. Consequently, there were several data points that could be examined to assess the likely impact – these can be assessed on a financial basis using predicted loss calculations, and on an operational basis reflecting the management procedures currently in place.

The financial impact of climate risk at the Mohammed bin Rashid Al Maktoum Solar Park was estimated based upon the expected damage ratio associated with specific climate perils, and the insured value of the solar park. The potential cost of damage assumes no mitigation or adaptation from the current state but can provide useful information to support decision making and investment priority-setting.

This presents a significant physical and financial risk and emphasises the need for climate adaptation. DEWA have demonstrated good understanding of this risk and have already installed resilience measures that will reduce the impact of climate change in future decades. This study helps to target and specific interventions that will be required and provides a timeline for adaptation that can assist DEWA in its investment decision-making.

Measuring impact also considered current levels of resilience within the site and at an organisation level within DEWA. Future investment, refurbishment, and replacement strategies could be informed by this impact assessment phase. This will support DEWA in continuing its climate adaptation and ensure timely action to mitigate the identified risks. It is worth noting that climate predictions are estimations of future conditions and resilience planning should always include some capacity for further adaptation in an uncertain future.

DEWA demonstrated significant awareness of climate risk at the Mohammed bin Rashid Al Maktoum Solar Park and have developed a suite of resilience measures in response to these risks. The measures developed from previous experiences at the site had showed a strong leadership strategy of monitoring, evaluation, and adaptation.

Specific measures included the design and construction of surface water management solutions that have been implemented across the site. The capacity of these systems reflected the flood events experienced at the site and has allowed a network of flood resilience measures to be created.

The risk of overland flooding was also recognised by DEWA, although this hazard had not yet affected the site. DEWA has already begun to prepare for this risk as its likelihood increases across the study timeline. The impact of cloud seeding on current and future flood risk was not considered in detail as part of this study. The relationship between these factors is complex and requires further detailed analysis.

DEWA had also developed physical adaptation and management procedures to lessen the impact of storm events. Although extreme wind is not predicted to have significant impact at the site, recent events have highlighted the importance of mitigating this risk.

Step 3: Climate adaptation recommendation at the Mohammed bin Rashid Al Maktoum Solar Park

The assessment of climate risk and its likely impact at the Mohammed bin Rashid Al Maktoum Solar Park led to detailed and collaborative discussions between DEWA and Marsh to develop practical adaptation recommendations. The purpose of this adaptation was to support and enhance the measures already established by DEWA and reflect the specific climate risk and severities informed by climate modelling.

In 2020, DEWA has developed a comprehensive Climate Change Resilience Plan that is driven by a vision, guiding principles, approach, and goals to ensure the resilience of the power and water sector of Emirate of Dubai. DEWA's Climate Change Resilience Plan identifies detailed existing mitigation measures, preventive controls and future resilience actions that address potential impacts of various climate change drivers on its business and operations.

The adaptation measures for the Mohammed bin Rashid Al Maktoum Solar Park were defined within the hardware, software, and emergency response categories, shown in Table 1. Adaptation priorities were informed by the extent of the predicted climate risk, the current levels of resilience at the site, and the practicality of making improvements to mitigate risk.

The level of resilience already embedded at the Mohammed bin Rashid Al Maktoum Solar Park was significant and a reflection of the leadership and management deployed by DEWA at the site. It is important to recognise however, that the changing climate risk profile will require consistent monitoring and periodic re-assessment to ensure the site remains safe and resilient. This requirement is not specific to DEWA or this location and is a reflection of challenges all organisations will face in the coming years.

Future resilience at the Mohammed bin Rashid Al Maktoum Solar Park will be delivered by DEWA as two strands of activity:

- As part of current resilience measures and those already in development of the coming period.
- As part of a program of monitoring and re-assessment based upon 'on-site' experiences and climate risk prediction modelling.

A climate resilience and adaptation timeline has been developed for the Mohammed bin Rashid Al Maktoum Solar Park. This timeline, shown in Figure 3, reflects the changing climate risk profile and the mitigation measures that should be considered or implemented as a response. The development of this timeline will shape the plans that DEWA have to ensure the Mohammed bin Rashid Al Maktoum Solar Park remains resilient to climate risks today, and in the coming decades.

Table 1. Adaptation recommendations for the Mohammed bin Rashid Al Maktoum Solar Park.

	Hardware	Software	Emergency response
Higher priority	**1.** Ensure the surface water management system that removes water from the site perimeter of the site is well-maintained and has the capacity to manage flood water effectively. **2.** Liaise with the local municipality / authority to determine any capacity limitations on area-based flood risk management. **3.** Investigate any required changes to the specification of panel mounting systems to improve anchoring and resistance to demounting for the future phases.	**1.** Ensure communication of best practices across different phases of the park, for example successes in managing climate risk should be shared across all stakeholders **2.** Identify the location of critical infrastructure (such as power and IT systems) and ensure they are adequately protected from the identified climate risks **3.** Schedule predictive maintenance to avoid daily and seasonal high temperatures.	**1.** Ensure active communications with local, regional and national storm warning systems **2.** Ensure the emergency response plan is detailed and effective to mitigate climate risks.
Lower priority	**4.** Create a flood water attenuation area that can be used to 'store' flood water and as part of the water management system **5.** Ensure on site temperature monitoring is used to assess design operating limits of assets and infrastructure.	**4.** Ensure flood and storm warning alarm/ alert systems are adequate and well-maintained.	**3.** Ensure staff are familiar with flood management systems, alarm systems – regularly 'testing' emergency response procedures. **4.** Share 'best practice' experience and successful mitigation deployment across the site area via a communications platform.

03| Climate resilience and adaptation timeline for the Mohammed bin Rashid Al Maktoum Solar Park.

Conclusion and outlook

In a global context, climate change is posing unprecedented challenges to energy systems, as infrastructure is often not designed to withstand more frequent and intense weather extremes. Marsh McLennan's Flood Risk Index, for example, shows that 23% of the world's power generation capacity is currently threatened by flooding, with this share expected to increase to 37%, 41%, and 48% under the 1.5 °C, 2 °C, and 3.5 °C temperature increase scenarios.

Decarbonising energy systems is essential for achieving the net-zero goals. Electricity generation, heat production, and additional emissions from the energy sector accounted for 31% of global greenhouse gas emissions in 2020, highlighting how substantial investments in low-carbon generation are needed to prevent further increases in global temperatures.

The risk to energy generation, such as that illustrated the Mohammed bin Rashid Al Maktoum Solar Park case study, arrives and develops just as the pace around energy transition increases. Managing these, often conflicting, issues in the coming decades will be critical to ensure the successful deployment of renewable energy, and to support energy security within an increasingly uncertain climate.

In addition to the direct effects on a site and its assets, including the people who work there, there can also be indirect impacts, such as disruptions propagating through supply and value chains. This can compound any direct damage. Countries, communities, and businesses not directly exposed can still suffer from indirect impacts.

DEWA has demonstrated good awareness of climate risk, resilience and adaptation at the Mohammed bin Rashid Al Maktoum Solar Park. Resilience measures to mitigate the impact of flooding and wind are already well-established. This provides the solar park with a good level of climate resilience today – however, this should be continually reviewed and implemented consistently as future phases of the solar park are developed, and climate change impacts become more severe.

Critical to implementing resilience and adaptation will be leadership, clearly demonstrated by DEWA in this study. Data gathering, ongoing monitoring and review will remain key ingredients within the climate resilience and adaptation agenda, requiring collaboration and communication to deliver the required outcomes.

In summary, it is increasingly important for organisations across all sectors to understand their exposure to climate risk. These assessments can focus on owned assets, supply chain partners, critical locations, and more. The priority should be a clear understanding of current and future climate risk as a basis for developing resilience and adaptation. This will protect organisations from an uncertain future and give confidence to stakeholders. The case study on DEWA's Mohammed bin Rashid Al Maktoum Solar Park illustrates this process in detail and provides a template for others to follow.

About Marsh

Marsh is the world's leading insurance broker and risk advisor. With over 45,000 colleagues operating in 130 countries, Marsh serves commercial and individual clients with data-driven risk solutions and advisory services. Marsh is a business of Marsh McLennan (NYSE: MMC), the world's leading professional services firm in the areas of risk, strategy and people. With annual revenue over $20 billion, Marsh McLennan helps clients navigate an increasingly dynamic and complex environment through four market-leading businesses: Marsh, Guy Carpenter, Mercer and Oliver Wyman. For more information, visit marsh.com, and follow us on LinkedIn and Twitter.

About DEWA

Dubai Electricity and Water Authority, DEWA PJSC, is a Dubai government owned utility and is the sole provider of electricity and water in the Emirate of Dubai. DEWA's core business is to operate and maintain its power stations, desalination plants, aquifers, power and water transmission lines and power and water distribution networks in Dubai. In line with its vision to become a globally leading sustainable innovative corporation committed to achieving Net-Zero by 2050, DEWA is committed to provide 100% of energy from clean energy sources by 2050.

For more information, visit dewa.gov.ae

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