strategy&

A sustainable built environment

Seizing the Middle East's US$2 trillion opportunity

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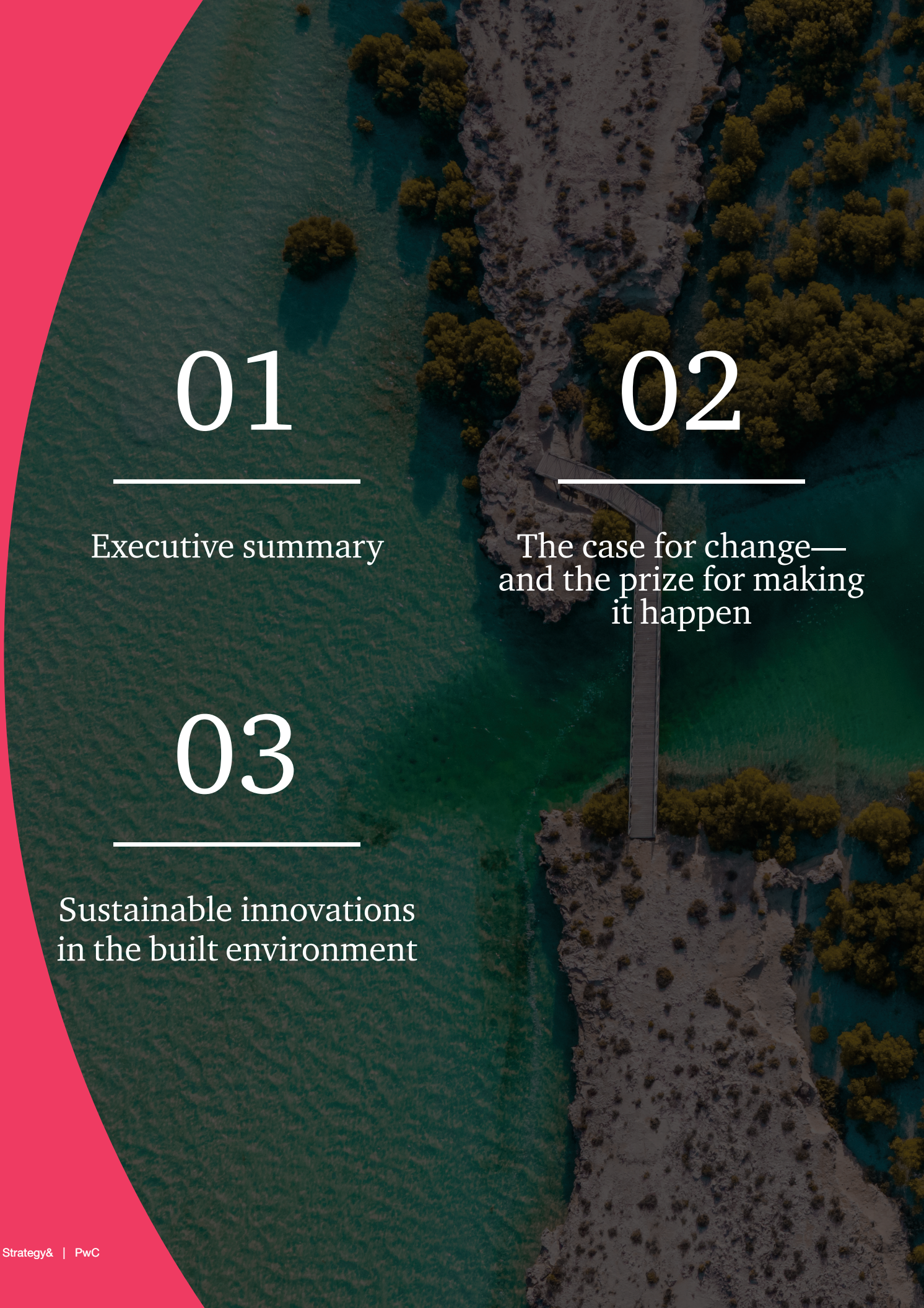

01

Executive summary

Countries in the Middle East and North Africa (MENA) are in the midst of a massive construction boom, with whole new cities—not just new buildings—taking shape across the region. About 30 high-profile mega projects, such as construction of the NEOM futuristic city in Saudi Arabia, Qatar's planned Lusail entertainment city, and the DP World/EMAAR Mina Rashid Redevelopment project in the United Arab Emirates (UAE), are already confirmed, and that is just the start. Across the MENA region, primarily in Gulf Cooperation Council (GCC) countries,[1] plans are coming together to invest US$2 trillion in construction projects by 2035.

As the region proceeds with this build-out, it has some critical choices to make. Overall, the built environment (by which we mean the human-made surroundings that provide the setting for human activity, including buildings, neighborhoods, and cities, and their supporting infrastructure systems such as water supply and energy networks) is responsible for about 37 percent of energy use, 39 percent of CO_2 emissions, and 40 percent of material use globally.[2] At a time when governments across the Middle East have made ambitious commitments to reduce emissions and develop more sustainable sources of energy, the construction boom thus offers an extraordinary opportunity for the region to become a pioneer in the development and use of sustainable technologies and techniques for the built environment.

Driving innovation in this space could significantly contribute to the region's efforts to reach net-zero emissions of greenhouse gases (GHGs): We estimate that the reduction in life-cycle emissions for urban development could contribute more than half of the total emissions reduction efforts required. (Developing a clean electric grid, which is not covered in this report, would be the other main driver of emissions reduction.) Tangible benefits of rigorously applying sustainable methods and materials to the built environment would include widespread better quality of life, incremental economic growth, and the development of enhanced local skills and jobs. More broadly, it could set a new global standard for all.

The opportunity is very real; however, seizing it will require dedication and focus across a number of dimensions, including technology investments and upgrading local capabilities. This report takes a closer look at the region's $2 trillion opportunity to become a global leader in the built environment space, highlighting both the opportunities and the challenges. We detail 17 ways in which techniques and approaches to the built environment would need to change, covering more than 50 innovations and technologies. The starting point is a fundamental shift in thinking, an acceptance that traditional techniques need to be updated for the net-zero era. We conclude with some actions that key stakeholders—whether regulators, developers, or sovereign wealth funds—would need to take to make this happen.

The efforts would be considerable and concerted, but the outcome would easily be worthwhile in terms of achieving three key objectives: sustainability, higher quality of life, and localization.

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The case for change—and the prize for making it happen

The built environment includes urban planning, real estate, construction, and operating assets. The embodied carbon in buildings alone accounts for as much as 39 percent of energy-related carbon emissions globally.[3] The sector as a whole will need to reduce CO_2 emissions and offset the remaining emissions by 2040 to meet current 1.5°C global warming targets under the 2015 Paris Agreement.

There is considerable room in Middle East and North Africa (MENA) countries to address sustainability issues in the built environment. For example, less than 5% of the region's[4] energy supply currently comes from renewable energy sources, although governments across the region are rapidly stepping up the construction of solar and wind energy installations. By 2030, Saudi Arabia aims for a renewable energy contribution of 50 percent, and most other Gulf Cooperation Council (GCC) countries are targeting 25 to 30 percent. The GCC region has a substantial renewable energy cost advantage over other regions, especially for solar energy: Six of the 10 existing lowest-cost solar projects globally are in the GCC, with a levelized cost of electricity that is just one-fifth of the global average for solar photovoltaic output.[5]

The $2 trillion in investment encompasses projects in GCC countries and Egypt and can substantially underscore the region's commitments to decarbonization.[6] Saudi Arabia has pledged more than SAR 700 billion (US$186.6 billion) to meet net-zero emissions targets by 2060.[7] The UAE and Oman have set net-zero targets for 2050, with plans to become leaders in low-carbon and green hydrogen, respectively. Similarly, Egypt and Qatar have announced plans to reduce GHG emissions in some of the heaviest-polluting sectors by 2030.

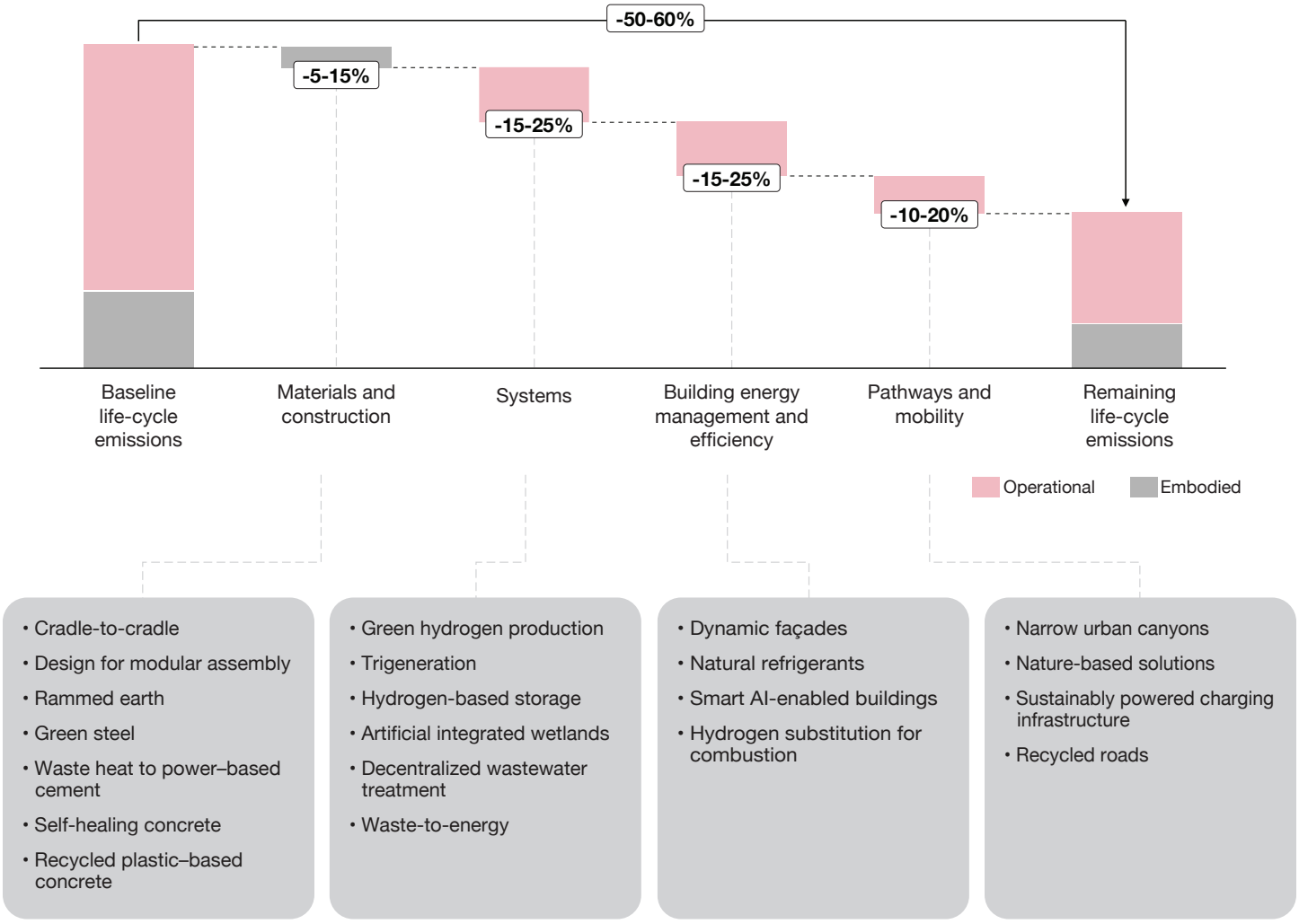
The size of the investment will have a substantial economic impact: It represents a little over 10 percent of GDP for the region annually, and we estimate it will create about 4.3 million jobs per year.[8] But the essential challenge is the extent to which the investment will drive innovation in sustainability and elevate the region to a position of global leadership for the built environment.

Success in achieving environmental sustainability will translate into eight main objectives. Increasing renewable power generation and optimizing consumption, including reducing emissions from mobility, is one of them. The others are strengthening climate resilience and responsiveness to climate risks; reducing noise pollution; conserving the natural ecosystem and protecting and reversing the decline in biodiversity; improving indoor and outdoor air quality; reducing GHG emissions from embodied carbon; rationalizing water consumption; and minimizing waste generation. Achieving these goals would make a substantial difference in moving closer to achieving several of the United Nations Sustainable Development Goals, including those relating to sustainable cities, and targets for clean energy and water.

Although all eight of these objectives will need to come together, there is some interdependence between them (for example, reducing emissions from mobility can help improve air quality and potentially also lead to a reduction in noise pollution). For this research, we have focused on decarbonization as a key objective. We have made an attempt to calculate what the impact on emissions would be from adopting a sustainability-focused approach to the region's investment in the built environment. To do so, we focused on 17 discrete areas of innovation in the built environment, and looked at the carbon reduction potential of each. The 17 areas span four categories of the built environment that cover both embodied carbon and operational carbon. The four categories are materials and construction; systems; building energy management and efficiency; and pathways and mobility. We considered only a sample set of innovations, because some overlap or can be replaced. Even with these caveats, we estimate that an innovative and sustainability-focused allocation of the $2 trillion in spending could potentially reduce life-cycle emissions by as much as 50 to 60 percent *(see Exhibit 1).*

Exhibit 1

Focusing built environment spending on sustainability innovations could reduce emissions by 50 to 60 percent over the life cycle

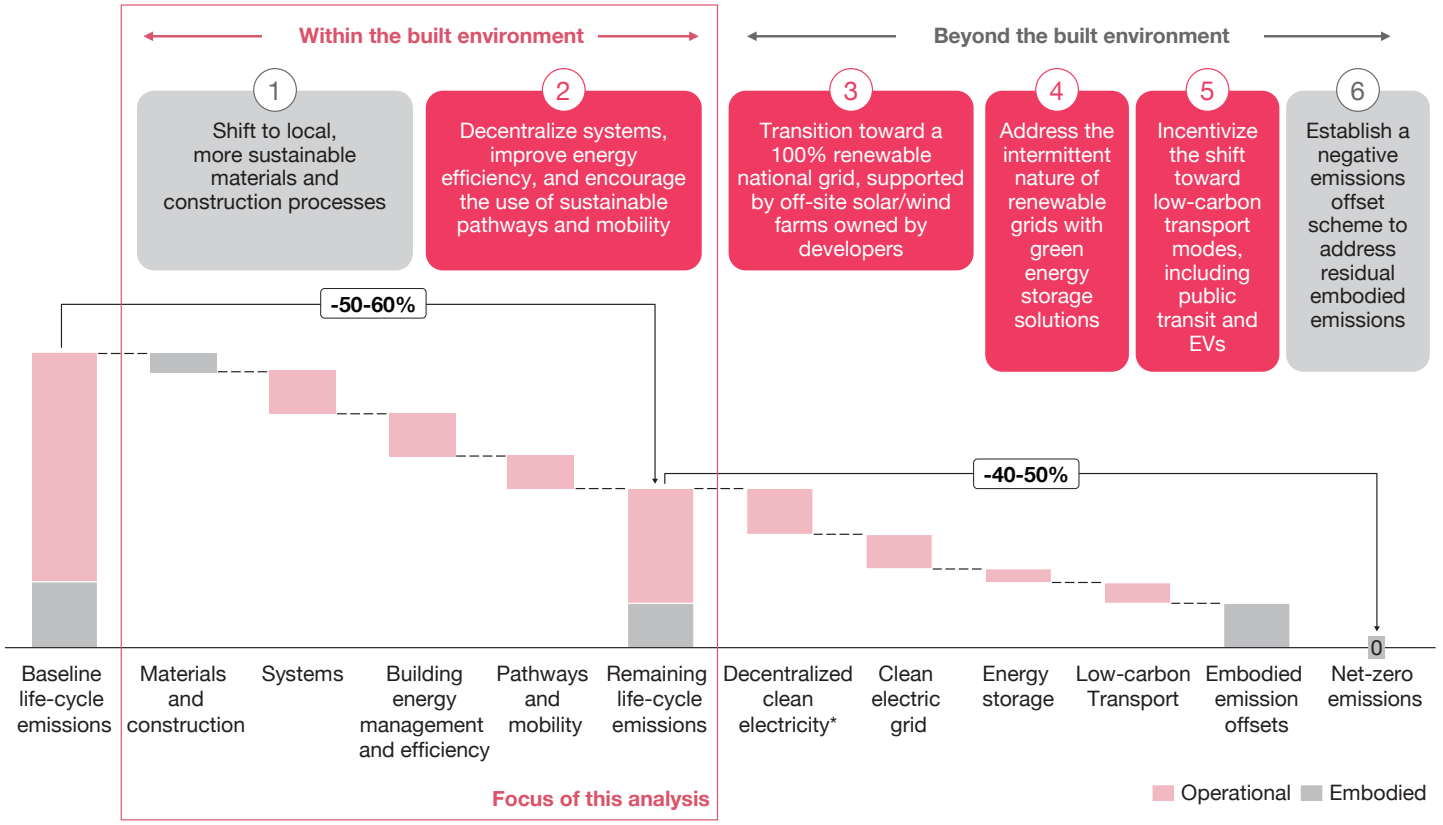


Note: This analysis includes only some high-performance innovations with significant carbon reductions, as listed above, not the entire list of innovations assessed.
Source: Strategy& analysis, Dar Al-Handasah Consultants (Shair and Partners)

A reduction of this magnitude in life-cycle emissions from the built environment will make a significant contribution to the broader goal of achieving net-zero emissions. Innovations in the built environment on their own can help take the region part of the way to net zero: We estimate these innovations could account for as much as 60 percent of the total emissions reduction needed. Other major efforts would also be needed. In particular, the transition to a net-zero national grid in countries across the region would be required, as would energy storage solutions that can address a key obstacle to widespread use of renewable energies, namely intermittent supply. Developers would play a larger role in supporting the grid by owning off-site solar and wind farms that directly serve their developments. There would also need to be a transition toward low-carbon mobility (going from private internal combustion engine cars to low-carbon public transit and electric vehicles [EVs]), Residual emissions would then need to be offset in order to fully achieve net zero *(see Exhibit 2).*

Exhibit 2

Achieving net zero will require action beyond the built environment, including a renewable grid supported by developer-owned energy farms



*Solar, wind, or hybrid farms owned by developers and directly serving the development.
Source: Strategy& analysis, Dar Al-Handasah Consultants (Shair and Partners)

03

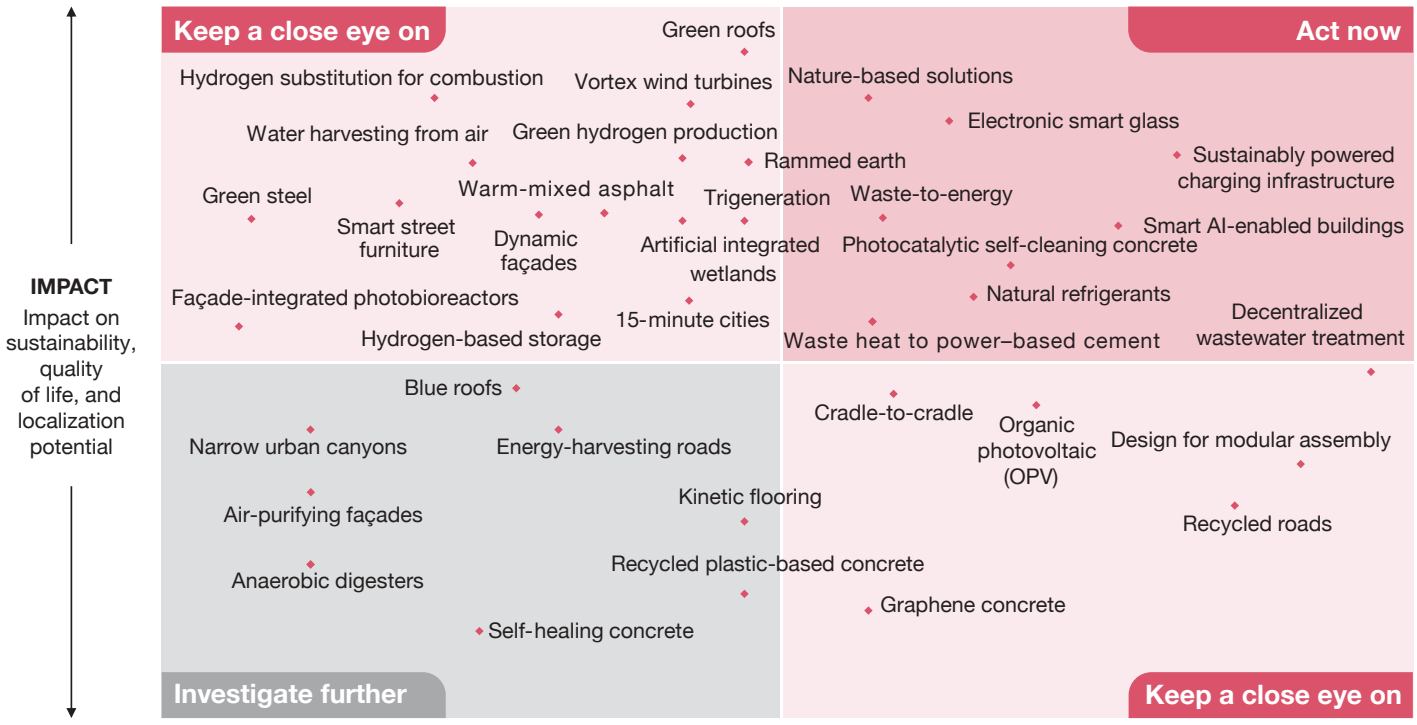
Sustainable innovations in the built environment

Some of the technologies and innovations needed to rethink the built environment already exist and can be implemented in the near term, such as solar photovoltaics and artificial intelligence (AI)-enabled systems in buildings, whereas others are nascent and require additional investment and time to develop, test, and integrate. Particularly in need of more work are technologies that can help abate emissions in the production of materials such as steel and concrete.

The more fundamental issue for Middle East stakeholders to address is whether they will embrace an innovative approach to urban development. Doing so will require a paradigm shift, a change of mentality about how to use the investments in the built environment to further the region's sustainability agenda. The new thinking that is part of this paradigm shift will have implications for the full life cycle of the built environment: urban planning, architecture, civil engineering, mechanical systems, electrical and plumbing systems, materials, and construction and demolition. It will also require new and different types of measurement. Players in the built environment can determine potential actions by weighing traditional metrics that reflect project feasibility, such as time, cost, and built quality, against the new metrics, which include impacts on sustainability, on quality of life, and on localization (which refers to locally based companies, local materials, and the local workforce) *(see Exhibit 3).*

Exhibit 3

Selected innovations will allow the region to achieve both traditional and new metrics



Source: Strategy& analysis, Dar Al-Handasah Consultants (Shair and Partners)

The innovations we examined in this research cover more than 50 technologies that can help turn the larger paradigm shift into an enduring practical approach to creating a sustainable built environment—and lead to a substantial reduction in emissions. These innovations reduce emissions from both embodied carbon and operational carbon. Together they cover a variety of passive measures including the design of buildings and the passageways, or "urban canyons," between them, as well as active measures such as more efficient electrical and mechanical systems.

Many actions can be taken to ensure that the paradigm shift discussed above translates into specific changes in design, construction, and operations. In this section, we focus on 17 high-potential action areas. Exhibit 4 highlights measures related to development and buildings.

Exhibit 4

Innovations across the various elements of the built environment will contribute to emissions reduction

Development/ urban planning

1. Rethink the density of developments for sustainability
2. Decentralize power generation
3. Build storage for dynamic energy management
4. Decentralize water generation
5. Decentralize wastewater treatment
6. Achieve circularity with waste-to-energy
7. Adopt nature-based solutions
8. Electrify micro-mobility
9. Build sustainable pathways

Asset/ buildings

10. Rethink façades for energy saving
11. Give roofs a sustainability purpose
12. Rethink flooring for energy generation
13. Move to smart buildings with comfort-based systems
14. Eliminate embodied energy of HVAC systems
15. Electrify mechanical, electric and plumbing (MEP) systems
16. Deploy sustainable materials
17. Design for modular assembly or construction

Source: Desktop research, Strategy& analysis, Dar Al-Handasah Consultants (Shair and Partners)

The asset mix

1. **Rethink the density of developments for sustainability:** An increasingly important goal of urban planning in the region is accessibility to thermal comfort for residents and those participating in outdoor activities. One solution is for urban designers and policymakers to rethink urban canyons, a term that refers to streets flanked by buildings on either side. In the past, urban canyons trapped heat and blocked natural breezes. However, they can be rethought to improve air recirculation and provide natural sources of shade. This design approach also lends itself to the development of "15-minute cities," where residents can access basic amenities and services within a 15-minute walk or bike ride.

Supporting systems

2. **Decentralize power generation:** Energy production facilities, such as solar farms, can be built closer to where electricity is actually needed. This would not only reduce transmission and distribution costs but also provide reliable sources of renewable energy generation.

3. **Build storage for dynamic energy management:** Hydrogen is a clean-burning fuel, with only water vapor as a by-product, which makes it an ideal energy carrier. It can also be stored as either gas or liquid. Such versatility allows for dynamic pricing and energy management, which can be further reinforced with battery storage systems.

4. **Decentralize water generation:** As with decentralized power generation, water sources can be moved closer to where they are needed. On this point, moisture can be extracted from the air using dehumidifier units. From there, particles and impurities can be removed, and potable water can be created for drinking, irrigation, and household use.

5. **Decentralize wastewater treatment:** Wastewater can also be treated at the site of generation, which reduces GHG emissions by nearly 90 percent and decreases energy consumption from pumping water to the treatment site.[9] This can reduce regional reliance on desalination and can be a key input in green hydrogen production and the implementation of nature-based solutions. On this point, stormwater wetlands can be constructed to incorporate vegetation in order to treat water and remove pollutants.

6. **Achieve circularity with waste-to-energy:** Historically, municipal solid waste has been processed at waste-to-energy plants or landfills to produce energy. New innovations, such as anaerobic digesters, can effectively close the loop on waste-to-energy by supporting sustainable biogas systems.

Managed landscapes

7. **Adopt nature-based solutions:** Carrying over the concept of stormwater—or "constructed"—wetlands, there is further potential to integrate the natural world with the built environment. Doing so entails habitat provision, which provides shelter, protection, and food sources for organisms in wetland ecosystems, and connectivity, which accounts for the distribution of these populations. There is significant potential here, as the region boasts 223 wetlands across 13 countries, including Afghanistan, Syria, and Yemen.[10]

Mobility options

8. **Electrify micro-mobility:** Charging equipment for micro-mobility options, such as e-bikes and e-scooters, can be powered by sustainable energy sources. Wireless charging could also help eliminate operating costs. As another approach, sensors can be added to modular street furniture and bike racks to gather quality-of-life information, such as the level of traffic, and optimize city services.

9. **Build sustainable pathways:** Sustainably powered charging infrastructure can reduce emissions by 86 percent. Energy-harvesting roads can generate green electricity to power urban infrastructure, while also reducing carbon emissions. Recycled roads can reduce embodied carbon by more than 90 percent—and they can be half as costly as traditional asphalt roads, and require less energy for their production. Photovoltaics can also be added to roads to provide energy for streetlights and charging infrastructure.

Asset exteriors

10. **Rethink façades for energy saving:** Static shading systems, such as blinds and curtains, are not sufficient to make indoor temperatures more comfortable for many residents in MENA countries. In addition, inefficient building façades can lose up to 40 percent of the energy generated indoors,[11] leading to a significant increase in direct energy consumption. Dynamic façades change in response to the surrounding environment and can increase the amount of useful daylight directed to buildings, while allowing energy savings of up to 55 percent. Additionally, integrating photosynthetic micro-algae into the glazing can increase shading, absorb CO_2, and produce biomass through solar radiation.

11. **Give roofs a sustainability purpose:** Also known as "vegetated" or "living" roofs, green roofs can make roof surfaces 30 to 40 percent cooler.[12] They have the added benefit of retaining stormwater, which is particularly important in the MENA region. Another method of collecting, storing, and releasing stormwater is blue roofs, a system of detention ponds.

Asset interiors

12. **Rethink flooring for energy generation:** Kinetic tiles can capture the energy created by people as they walk or run across the floor. This energy is then stored in batteries, where it can be used to generate power. The market for kinetic floor tiles is largely untapped in the region, but it is expected to grow significantly in the years to come.

Mechanical, electrical, and plumbing systems

13. **Move to smart buildings with comfort-based systems:** Smart systems and buildings are more energy efficient as well as increasingly comfortable and safe. The Middle East is already a world leader in this area. In the UAE, buildings such as the Opus integrate smart climate controls into the façade.[13]

14. **Reduce embodied energy of HVAC systems:** Research shows that the embodied carbon of HVAC installations is equivalent to the CO_2 emitted over 2.3 years of operation.[14] Natural refrigerants, such as ammonia, hydrocarbons, and water, can help reduce these emissions, and reduce the environmental damage caused by synthetic refrigerants.

15. **Electrify mechanical, electrical, and plumbing (MEP) systems:** Estimates show that most residents in MENA countries spend as much as 90 percent of their time indoors, yet indoor air can be five times as polluted as outdoor air.[15] Electrifying MEP systems can improve air quality and emit 90 percent less pollution than conventional systems that are based on combustion systems, such as generators.

Materials

16. **Deploy sustainable materials:** To produce and use materials more sustainably, and to reduce the amount of waste generated from construction, regional developers could benefit greatly from the circularity that comes with the cradle-to-cradle model. Closing the materials loop helps maintain sustainability across the entire supply chain, from the design stage through decommissioning, and has the potential to reduce carbon emissions by at least 15 percent throughout the life cycle of materials.[16]

Construction processes

17. **Design for modular assembly or construction:** Designing for modular assembly involves building an asset out of smaller, interchangeable components. These modules are prefabricated and standardized, which means they can be easily mixed and matched. In addition to the operational savings, modularity can reduce embodied carbon emissions by more than 19 percent over the lifetime of the built asset.[17]

INNOVATIONS TO REDUCE EMBODIED CARBON EMISSIONS IN MATERIALS AND CONSTRUCTION PROCESSES

Embodied carbon refers to the emissions that arise from materials and construction processes. Construction materials are easily the biggest contributor to embodied carbon emissions, accounting for between 65 and 85 percent of a typical building's life-cycle embodied carbon emissions.[18] The amount of embodied carbon emitted depends on several decisions made across the material life-cycle model, from design and material extraction, through manufacturing, transportation, construction, usage, and then either waste disposal or recycling. By way of example, the changes in thinking and practice that would be required include:

Cradle-to-cradle construction techniques: Conventional construction has a high level of emissions in part because materials are wasted. Recycling or upcycling so that construction becomes part of a natural life cycle is a fundamentally different and more sustainable approach, often known as cradle-to-cradle (C2C) construction. As a whole, C2C leads to a substantial reduction in embodied carbon; based on Dar Al-Handasah Consultants (Shair and Partners) observations across its GCC projects, the reduction in embodied carbon compared with traditional construction can be about 15 percent.[19] C2C techniques include reinforcing concrete with recycled plastic instead of steel. This can help reduce the number of resources needed to produce concrete, and the end result is five times as strong as steel relative to its weight.[20]

Design for manufacture and assembly: Traditional construction takes place mainly on-site and can lead to high levels of waste and inefficiency, and can result in significant transportation activities with accompanying emissions. The alternative approach involves buildings being designed and engineered off-site, often while the foundation is being laid. Although some form of prefabrication exists across the region, modular construction of megacities has only recently gained traction. If standardized designs become more widely accepted, this innovative process could reduce embodied emissions by nearly 20 percent, cut costs by 30 percent, and lead to an improvement in worker safety of up to 70 percent.

Rammed earth and graphene concrete: For raw material extraction, this shift would involve moving from extracting virgin materials to using alternative materials and reinforcements. Alternative materials include rammed earth construction, which uses compacted raw materials. Alternative reinforcements include graphene concrete, which is fortified with carbon atoms extracted from graphite. These innovations hold the potential to reduce embodied carbon emissions by 30 to 50 percent, with strong localization potential across the region.[21, 22]

Green steel and waste heat to power–based cement: Two key shifts need to take place across the GCC construction industry to reduce emissions from materials manufacturing. First is the transition to greener fuels. Second is increased energy-efficient production. Both can be achieved with innovations such as green steel and waste heat to power (WHP)–based cement. Green steel is powered by green hydrogen, which is produced through electrolysis using renewable energy sources. It can reduce emissions by as much as 95 percent, and it could potentially leverage green hydrogen produced in the region. WHP systems function by capturing waste heat generated during production processes and converting it to usable power, which is then typically used to manufacture cement. The impact on embodied emissions is again very significant, with reductions of as much as 90 percent. WHP can generate 30 percent of the electricity needed to produce cement.

Photocatalytic self-cleaning concrete: Using traditional materials increases the embodied carbon emitted during the maintenance process because more repairs are required, and problem areas are not always easily accessible. This increases the significance of shifting toward materials that react to external stimuli, such as photocatalytic self-cleaning concrete, which relies on sunlight to clean itself. This simultaneously prolongs its life and improves air quality by decomposing harmful gases, including volatile organic compounds and other pollutants. For now, self-cleaning concrete is four times as expensive as traditional concrete.[23] Increased local production of self-cleaning additives, along with economies of scale, could make it more commercially viable in the future.

INNOVATIONS TO REDUCE OPERATIONAL CARBON EMISSIONS

Operational carbon refers to emissions that arise from keeping buildings cool, ventilated, and powered, as well as emissions relating to pathways and mobility. Innovations in operational carbon can be combined to increase the use of renewable energy, encourage dynamic energy management with better power storage, and institute a circular water system *(see Exhibit 5)*. The innovations here can be used in building systems, in energy management of buildings, and in pathways and mobility.

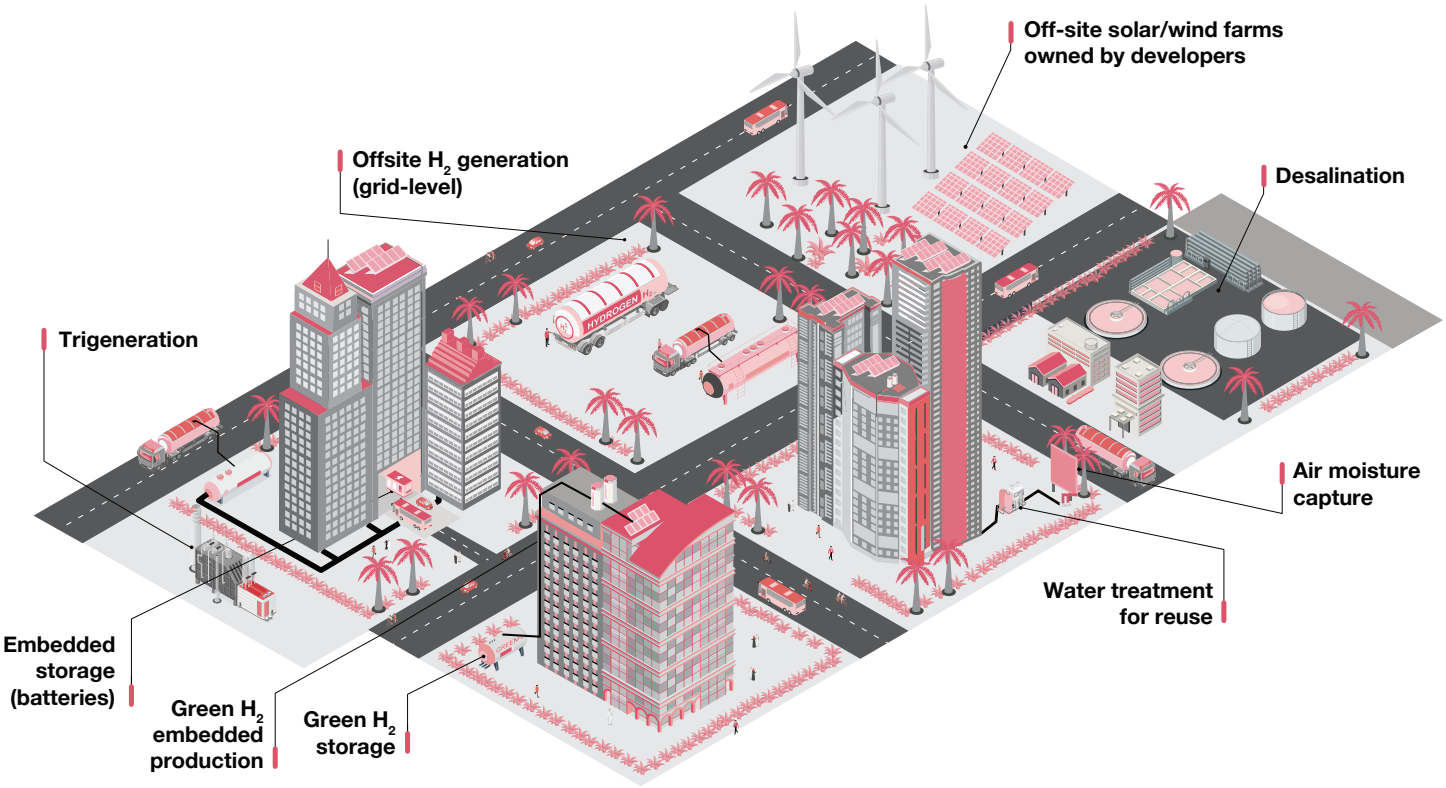
Building systems: Addressing the inefficiencies resulting from traditional systems of power generation and storage will rely on decentralizing power generation using renewable energy sources as well as connecting them to flexible storage solutions that respond effectively to changes in electricity demand. Green hydrogen and trigeneration can play important roles here.

Green hydrogen can be used for both fuel and storage and can provide reliable, renewable energy to residents. GCC countries are well positioned to become significant producers of clean hydrogen on a global scale, thanks to the abundance of their renewable energy sources and the availability of the required geography, land, and water. Green hydrogen production can eliminate the operational carbon emissions associated with power generation, especially given the regional push to increase demand for hydrogen products.

Trigeneration produces combined cooling, heat, and power from a single (often renewable) fuel input. Furthermore, decentralizing water generation from air and wastewater treatment presents opportunities for reducing stress on national water networks and minimizing the detrimental impact of desalination in the region, which has high water stress.[24] Decentralized wastewater treatment involves on-site treatment as a means of reducing the costs, emissions, and energy consumption involved. Trigeneration can reduce emissions by up to 30 percent. It also has a higher potential for localization, given the expected market growth of biomass fuel in the region.

Exhibit 5

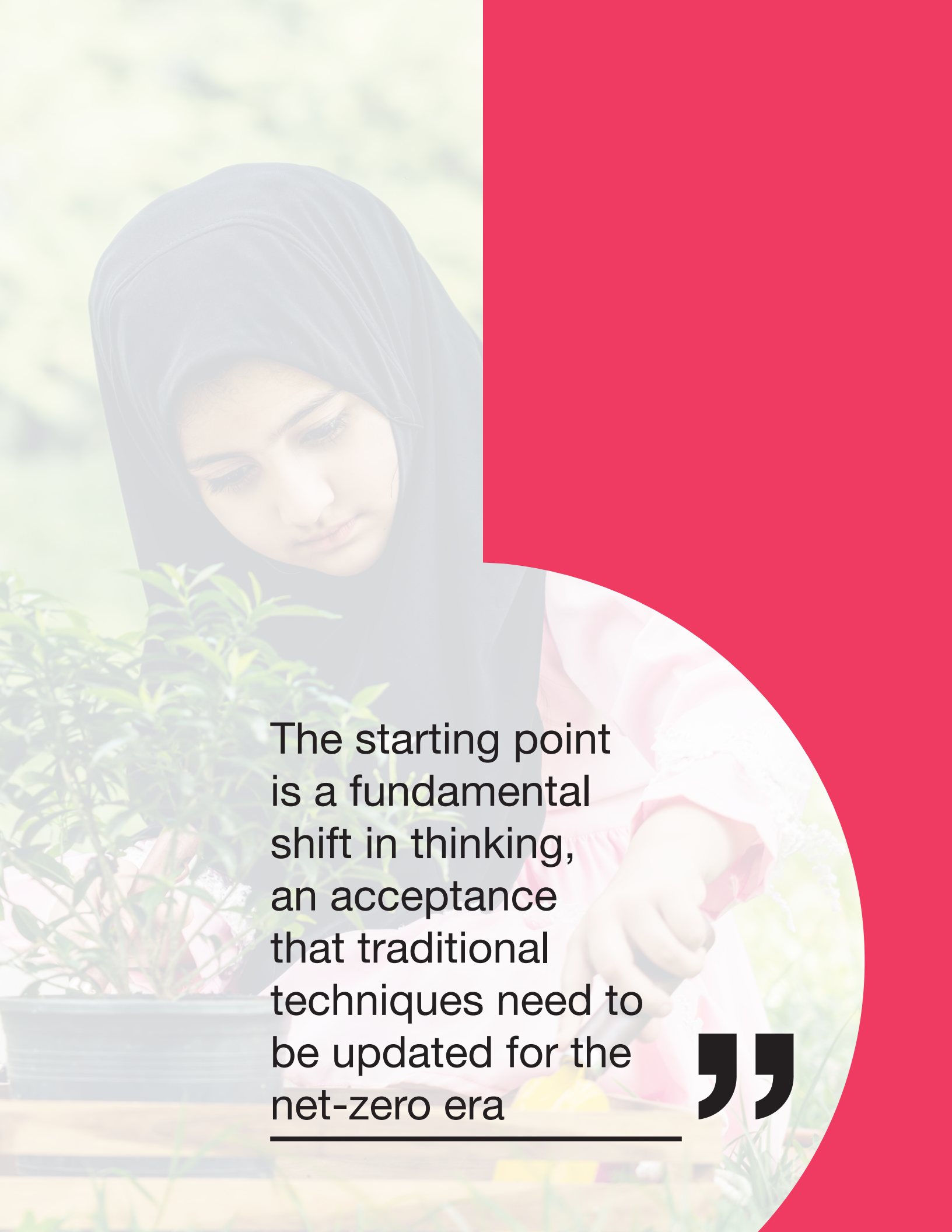
Innovation in building systems can reduce operational carbon emissions



Source: Strategy & analysis, Dar Al-Handasah Consultants (Shair and Partners)

Energy management and efficiency: In the MENA region, actual and sensed temperatures can rise as high as 56°C.[25, 26] These conditions limit walkability and require special building materials, shading systems, and powerful and efficient cooling systems to address them. More actions can be taken to improve air quality and residents' thermal comfort, reduce noise pollution, and buttress biodiversity preservation. Available technologies for buildings include dynamic façades that open and close in response to changes in sunlight, which have the potential to reduce energy consumption by 46 percent,[27] on average, and air-purifying façades that integrate greenery and purifying systems and actively remove pollutants from the air. This technology is expected to reduce pollutants by 30 percent,[28] reduce energy costs by 51 percent,[29] increase protection from solar heat by 78 percent, and absorb 41 percent[30] more noise than traditional walls, optimizing the indoor environmental quality.[31] Continued progress in AI means that beyond façades, building management can be predicted and optimized based on climate and consumer behavior patterns.

Pathways and mobility: Traditional urban planning treated pathways as static and focused attention on mobility mainly to improve the ease of internal combustion engine–driven transport. A sustainable and innovative approach upends this thinking, making both pathways and mobility more dynamic and more closely tied into a low- or no-emissions environment. This category of innovation covers a variety of technologies to improve mobility, including sustainable charging stations for electric bikes and scooters, energy-harvesting roads that can charge electric vehicles, and the use of recycled plastic in roads and pavement.



The starting point is a fundamental shift in thinking, an acceptance that traditional techniques need to be updated for the net-zero era

04

Paths forward

For the innovations we have outlined above to become a reality at scale will require changes and upgrades in a number of areas. Here we highlight four key areas: regulation; investment; research, development, and innovation; and new skills for the workforce.

Regulation: Creating demand for a sustainable built environment

Regulators have a critical role to play in helping create demand for a sustainable built environment and for the innovations that will enable it. They have three main tools. First, they can develop and enforce innovative and comprehensive green and sustainable building codes and standards with clear carbon reduction targets. For now, there is no commonly agreed-upon global framework that defines and regulates sustainability in the built environment. Some international guidelines, such as LEED, BREEAM, and EDGE, rely on international accreditations, but these are not always comprehensive or tailored to the MENA region and its specifics. At the same time, local standards do not always translate into international ones. Second, regulators can push the boundaries of innovation by recommending nontraditional materials and processes as part of their building codes and standards. These could include, for example, use of concrete reinforced with recycled plastics rather than steel or testing new material such as graphene concrete. Third, regulators can collaborate with universities, engineering companies, startups, and entrepreneurs, as well as suppliers and manufacturers, to build libraries of standardized designs, material passports, and other digital documents listing all the materials used during an asset's life cycle.

Investment: Focusing and pooling efforts in a special fund

Multiple funding efforts are underway in GCC countries as companies and sovereign wealth funds (SWFs) look for investment opportunities. However, for now, without obvious demand, it is difficult to encourage the level of sustained and massive funding that would be needed to stimulate the innovation required. A new, virtuous cycle needs to be created, in which funding helps to stimulate supply of sustainable solutions and also to encourage their adoption. This can be done by setting up special funds to support the adoption of sustainable practices across the built environment. For example, sustainability funds can provide grants for R&D projects that seek to innovate in green technologies for the built environment and that are undertaken within specialized clusters to fast-track startups.

Financial markets are also increasingly receptive to green debt, including debt from Middle East issuers. In October 2022, Saudi Arabia's SWF, the Public Investment Fund, listed a debut $3 billion green bond on the London Stock Exchange and followed up with a second large issuance early in 2023.[32] Sustainability bonds can be issued that exclusively fund green and sustainable projects within the built environment. And lenders can offer consumers green mortgages that incentivize investment in sustainable communities. Other ideas to facilitate financing could also be tested. These include public–private partnerships, tax financing agreements that would subsidize some projects using tax incentives, and, in some MENA countries, access to regional development funds.

Beyond the substantial government programs for renewable energies and the built environment, climate tech funding for now has remained relatively modest, and entrepreneurs in the Middle East are still largely funding their own efforts, according to the latest data. Indeed, climate funding has tailed off since 2022, along with other venture funding, as interest rates have risen in the United States and Europe, cooling what had been a buoyant market. However, Middle East investors are investing more heavily in climate tech efforts outside the region, the latest data indicates.[33]

Research, development, and innovation: Building new, future-oriented capabilities

Today, only limited incentives are available to stimulate sustainable and smart innovation across the built environment, especially in the construction sector. An innovation ecosystem can bring together relevant stakeholders and ultimately position the MENA region as a pioneer of sustainable development as well as an export hub. Regional and international research and innovation clusters can make a difference. For example, sustainable materials research and innovation industrial clusters can be established to focus on sustainable materials such as graphene concrete, green steel or cement, and natural refrigerants.

To accelerate innovation in the built environment, a mission-oriented research and development fund could be created that finances applied R&D in the built environment and that accelerates innovations from around the world and brings them to the Middle East. Research and innovation clusters can also be established that focus on the transition to design for manufacture and assembly. Within these clusters, labs can be established in partnership with local, regional, and international research institutions and universities to research and prototype new sustainable technologies within these fields. And accelerators can be established in partnership with local, regional, and international players to turn global expertise into action and accelerate local implementation of paradigm shifts and innovations.

Governments and investors in the region will need to make calls as to where to focus efforts to play to regional strengths and needs, and ensure the most impact. In other research, we have identified five areas in which the region has a competitive advantage: solar and wind energy, energy to food, green hydrogen production, recycled plastics, and waste-to-energy.[34] The build-out of renewable energies and development of clean hydrogen will also be foundational for any efforts to develop low-emissions manufacturing in the region, which in turn will require development of new and nascent technologies including, potentially, carbon capture and storage. At a time when multiple different technologies are looking for funding and integration, the region will need to create a clear priority list and anchor its strategy on those technologies, rather than adopt a scattershot approach, to achieve the highest impact.

New skills for the workforce

Beyond technology requirements, the transition toward a sustainable built environment requires the solid foundation of a skilled labor force. There is an urgent need to both rethink ways to fill short-term skills gaps and put in place long-term educational programs that will boost the region's capabilities in civil engineering, material science, and chemistry, among other disciplines.

For the first, shorter-term needs, workshops and other practices can be used to rapidly upskill workers and create familiarity with sustainable practices. Longer-term efforts will inevitably be slower, as the region repurposes educational programs for the supply of talent and to be a differentiated hub. It will be important to take advantage of ongoing reforms now happening in the education system and put a premium on areas of expertise that are of particular relevance for the region, such as climate-resilient engineering and the hydrogen economy.

Although some of this will require new university specialization, much can also be done at a lower academic level. Technical and vocational training programs can address some of the gaps in skills that exist in the region. So can apprenticeship programs developed in partnership with leading innovators across the built environment, which include engineering firms with dedicated sustainability teams, leaders in modern methods of construction, and leaders in sustainable materials production. Although upgrading the local workforce skills is a key aim, it is only part of a broader human capital enhancement strategy. Equally important will be to attract international specialists to meet talent needs, especially in the initial phases.

Creating an innovation ecosystem can position the MENA region as a global pioneer of sustainable development and help meet its net-zero goals.

05

Next steps for stakeholders

The sheer scope of the changes necessary to fully capture this $2 trillion opportunity has significant implications for stakeholders in the built environment, particularly SWFs and other financiers, developers, and regulators. Collaboration is required among all stakeholders, and their success depends on sharing lessons learned from pilots and trials to drive the adoption of sustainable practices and innovations.

DEVELOPERS

Developers have a central role to play in embracing sustainable construction techniques. They should set targets for achieving specific sustainability goals such as reducing embodied emissions, as well as focusing on greater localization for materials. In the short term, large developers can invest in green building innovations and technologies to enhance long-term sustainability. Doing so will create meaningful incentives for contractors to adopt sustainable technologies and innovations as well as provide them with grants. They can also work with contractors to incorporate these technologies across all the projects they own.

At the same time, developers can focus on building R&D centers and investing in testing prototypes that are tailored to their projects.

SWFS AND OTHER FINANCIERS

Given the scale of SWFs, as well as the number of projects under their umbrellas, they can jump-start and drive the transition by setting net-zero aspirations for the developments that they are financing and championing. Setting such ambitious goals would signal the need for designers and engineering firms, construction companies, and suppliers or manufacturers to follow suit. Beyond the impact at the project level, these goals can trigger the transformation of the entire sector toward a more sustainable, innovative, and digitally enabled built environment.

SWFs can also start setting up specialized clusters and look to target their investment at specific aspects of the built environment, whether mature products that can make a difference and need to be scaled or promising early technologies that require seed money. Many of the 17 areas we covered above fall into the early technology category, including bladeless wind turbines, water harvesting from air, and smart AI-enabled systems and buildings. At the same time, SWFs can focus on ensuring these innovations are produced locally—using local companies and local materials wherever possible and appropriate, and helping develop local skills.

GOVERNMENTS

Governments have a critical role to play, first in embracing the paradigm shift and then in enabling it to happen in a way that furthers the local economy and workforce. One big step that would send a strong signal across the region would be to launch a mission-oriented fund for the sustainable built environment, as discussed above in the research section. Beyond that, governments have a range of actions they should take including, first, introducing policy changes that encourage and potentially provide incentives for sustainable production and procurement methods; second, revising or passing new laws that outline accepted and proscribed construction materials and practices; third, evolving building codes and standards and recommending nontraditional materials and processes that limit the adoption of certain innovations today; and finally, creating and promoting awareness of the opportunities and changes required. For example, regulators can collaborate with other stakeholders to build libraries of standardized designs, materials passports, and other digital documents that list the materials used during an asset's life cycle. Such libraries will provide a base for developers to choose from when planning and designing their projects or communities. They will also enable the transition to an increasingly modular, less labor-intensive construction industry.

Governments will also want to use the changed paradigm for the built environment to drive their localization policies. Among other examples, governments can pursue robust local content procurement policies to drive the adoption of local materials and products and give preference to companies that employ sustainable techniques and provide approved sustainable materials. This entails issuing green purchasing legislation that includes a list of preferred vendors for developers and builders to purchase from, as well as import restrictions where relevant. Although encouraging the use of local materials and services will result in a reduction in transport emissions and will stimulate local economies, such policies need to be revised and rebalanced on a regular basis to avoid sudden spikes in prices due to shortages in the local market.

ENGINEERS AND ARCHITECTS

Engineers, architects, and designers, along with suppliers, manufacturers, contractors, and other industry professionals, will need to form a continuous feedback loop for long-term sustainability to be achieved with minimal disruptions to the sector. Architects have a particularly important role to play in contributing to the formation of building standards and standardized design libraries, which they can do in conjunction with regulators. They also can make a substantial contribution to sustainable design education.

ACADEMIA

Academia has an essential role to play in raising skills and improving workforce capabilities that will be needed to implement a more sustainable built environment. As noted above, some important areas of knowledge, including climate engineering, will need to be emphasized and built out. Academic institutions can adapt curricula to include mandatory sustainability courses. In the short term, academics can build their expertise by convening and attending international events and share knowledge. In the medium term, institutions could support the establishment of green tech accelerators and house innovation labs.

Conclusion

The cranes are continuing to go up across the MENA region, heralding many more years of large-scale construction. Nowhere else in the world is building so much. And nowhere else is there such an opportunity to establish global leadership in ensuring that the built environment is sustainable and innovative. This opportunity will need to be seized quickly, so that existing plans can be brought in line with a consistently sustainability-focused approach. The upside for the Middle East will be calculated in dollars, but also in lifestyle quality—and in terms of the benefits for the planet.

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About the authors

Karim Abdallah

Karim Abdallah is a partner with Strategy& Middle East, part of the PwC network. Based in Dubai, he is a member of the family business, investments, and real estate practice in the Middle East. He leads the real estate platform in the Middle East, advising real estate developers, government entities, investment companies, and corporations with significant real estate portfolios. He offers support for strategy setting, organization design and restructuring, business planning, and feasibility studies for mega projects.

Dr. Yahya Anouti

Dr. Yahya Anouti is a partner with Strategy& Middle East. He is a member of the energy, chemicals, and utilities practice in the Middle East and leads the environmental, social, and governance (ESG) platform for PwC in the Middle East. He specializes in sustainability, resource-based sustainable development, and environment-related strategies, and he supports governments, national oil companies, international oil companies, and utility companies across Asia, Africa, Europe, the Middle East, and the United States.

Marwan Bejjani

Marwan Bejjani is a partner with Strategy& Middle East. Based in Dubai, he is the leader of the mobility, aerospace, infrastructure, and tourism practice in the Middle East. He supports clients in defining and implementing winning strategies across the construction ecosystem, including authorities, real estate developers, designers, contractors, and building material suppliers. He is a thought leader in construction, authoring multiple publications and viewpoints.

Sarah Al Feghali

Sarah Al Feghali is the moonshots and innovation lead at the Ideation Center, the leading think tank for Strategy& in the Middle East. Based in Dubai, she has more than 14 years of experience in public-sector consulting in the region and formerly served as an advisor to the United Arab Emirates' Prime Minister's Office and the UAE Government Accelerators, focusing on strategy and government innovation.

Balsam Nehme

Balsam Nehme is head of sustainability at Dar. She has more than 17 years of experience in the sustainability field and helps clients enhance their missions and meet project goals across sustainability areas including developing and delivering carbon reduction pathways, thanks to her expertise in net zero, embodied carbon, integrated design, resilience, circular economy, health and well-being, and green certifications. She chairs the Dar Group sustainability council and is leading group efforts to highlight Dar's sustainability strengths at COP28.

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Contacts

Authors

Karim Abdallah
Partner, Dubai
+971-4-436-3000
karim.abdallah
@strategyand.pwc.com

Dr. Yahya Anouti
Partner, Beirut
+961-1-985-655
yahya.anouti
@strategyand.pwc.com

Marwan Bejjani
Partner, Dubai
+971-4-436-3000
marwan.bejjani@
strategyandpwc.com

Sarah Al Feghali
Moonshots and Innovation
Lead, Ideation Center
+971-4-436-3000
sarah.alfeghali
@strategyand.pwc.com

Balsam Nehme
Head of Sustainability, DAR
+961-1-790003
balsam.nehme@dar.com

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