AECOM

Middle East

Property & Construction Handbook

2022

Delivering a better world

Foreword

Reflecting on the global economic recession brought on by the coronavirus pandemic, the overall global economy is experiencing a robust and rapid rebound, particularly in advanced economies. While this recovery remains positive, caution is required.

Mounting debt levels, the potential for additional pandemic waves, new variants, delays in agreement of international vaccination policies, unequal vaccination distribution and rising inflationary pressures have the potential to deliver further setbacks.

This edition of AECOM's Middle East Property & Construction Handbook 2022 assesses trends and new opportunities that have presented themselves during these unprecedented times. The handbook also reviews the impacts and threats experienced over the last 12 months on local, regional and international markets.

At AECOM, our goal has always been to develop and adapt our knowledge in line with the ever-changing trends and construction growth opportunities, as well as to provide agile, innovative and industry-leading solutions to our clients.

Within our detailed economic round-up, we discuss the global and MENA regions' current economic and construction performance, and present the upcoming challenges and expected future opportunities.

We have carefully selected articles written by AECOM specialists, that focus on prevailing themes within the construction and property market. These articles aim to provoke thoughts in relation to the growing opportunities within the Middle East on subjects such as repurposing underutilized buildings for food security challenges and inner-city agriculture. We also take a look at the construction industry's role in reducing global carbon emissions by addressing embodied carbon in construction, and examine the opportunities and challenges faced by public and private sector finances in regards to climate change action and disclosures in financial decision-making.

Finally, we delve into the recent chapter of AECOM's digital transformation journey by showcasing how our focus on innovative and transformative solutions are being employed to improve outcomes for our clients and communities.

As with previous years, we include as a point of reference a synopsis of typical regional procurement routes, forms of contract and building regulation compliance across the Middle East. The reference data section provides averaged international and regional cost data within the built environment. This data acts as an indicative high-level guide and comparison of building asset costs and should be used circumspectly.

Like the nature of any project, its interpretation is dependent upon several project specific factors and assumptions. For specific current and benchmarked cost data, please reach out to AECOM's Program Cost Consulting team to assist you in obtaining relevant and specific costs for projects.

We hope that you find our analysis, forecasts and construction market evaluations beneficial and of value in navigating your decision-making in 2022. We look forward to hopefully working together to deliver a better world.

As always, we continue to seek your feedback to support our drive for improvement. Please contact Marc Gibbons and Jonathan Dowes via **bi_middleeast@aecom.com** for further information.

AlUla, KSA

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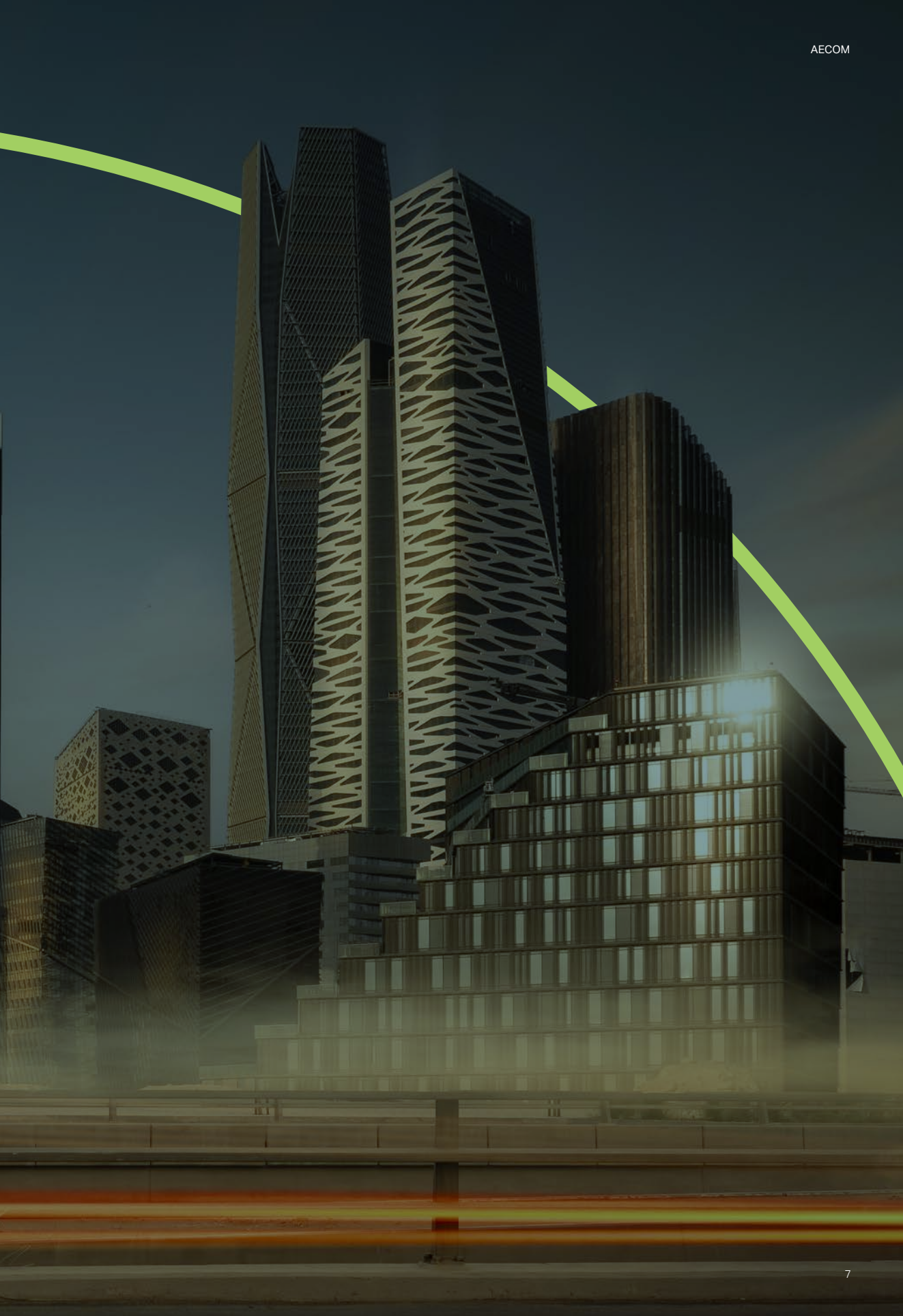


Global economic review

On review, the coronavirus pandemic's impact on the global economy caused a GDP decline on an annual basis greater than two times the decline caused by the global financial crisis of 2008.

2009 = -1.3 per cent, 2020 = -3.4 per cent, according to World Bank Group.

The subsequent rebound during 2020-2021, in particular for goods traded, has been rapid and much faster than that experienced in 2009 and the following years. Although the global growth outlook remains positive, led by strong recoveries in advanced economies and China, re-surging coronavirus infections, new variants, mismatched vaccination programs and unequal vaccine distribution in developing countries, continues to impede the overall recovery of the global economy.

The global GDP was forecasted to grow by 5.6 per cent in 2021 following a 3.5 per cent contraction in 2020. The GDP in 2022 is forecasted a growth of 4.3 per cent. The World Bank Group - Global Economic Prospects Report (2021) outlines that although forecasts are encouraging, they are expected to be highly uneven across different countries, especially developing economies. The World Bank Group caveat the substantial uncertainty of global markets in these unprecedented times and in their report they explore three scenarios for recovery and consider the associated impacts to the global economy.

Baseline scenario: Forecasted Recovery - Advanced economies achieve effective containment of coronavirus via widespread vaccination by the end of the year. Key developing economies significantly reduce local transmission rates.

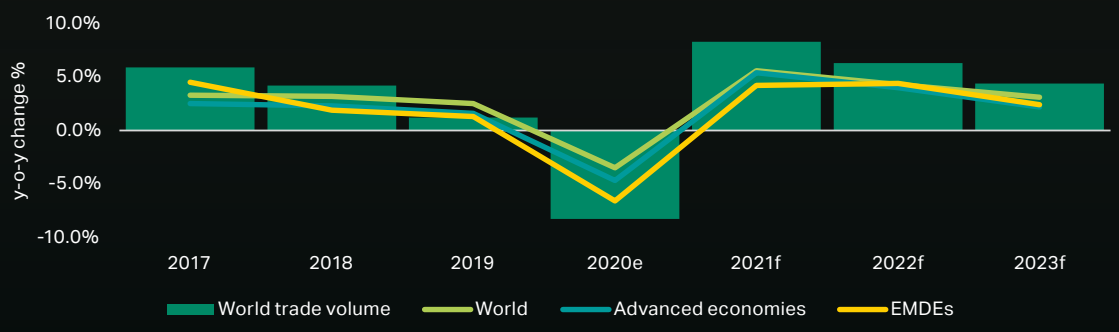
Upside scenario: Sustained Expansion - Accelerated technological adoption, rising investment and labour force participation strengthens output. The policy makers of developing economies implement growth-enhancing reforms and diversify from economies reliant on commodities or tourism

Downside scenario: A Faltering Recovery - Policy support is withdrawn, pent-up demand is exhausted, new pandemic variants are experienced, sustained inflation pressures by disparate supply and demand, increased debt servicing costs for governments limiting investment.

The above scenarios indicate the challenges for global recovery post-pandemic and in meeting current forecasts following the decline in 2020

Advanced economies are forecasted to see growth of 5.4 per cent in 2021 and 4.0 per cent in 2022 respectively, following the 4.7 per cent contraction in 2020. As for Emerging Markets and Developing Economies (EMDEs) they are forecasted to see growth of 6.0 per cent in 2021 and 4.7 per cent in 2022, following the 1.7 reduction in 2020.

Real GDP Growth



Source: World Bank Economic Prospects, June, 2021

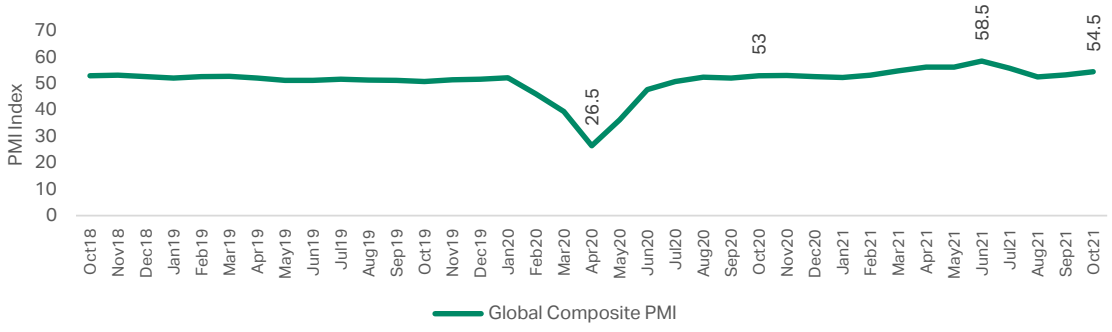
Purchasing Managers Index (PMI)

In April 2020, the global composite Purchasing Managers Index (PMI) sunk to a record low of 26.5 following the onset of the coronavirus pandemic — it quickly rebounded to above 50 points in July 2020

Since this period the PMI has remained above 52 (indicating month on month growth) and was recorded at 54.5 at the beginning of Q4 2021. The sentiment for business activity was set to remain positive until at least the end of 2021, however there were signs that confidence slightly reduced following continuing supply disruptions and persistent inflationary forces.

The inflationary pressures of elevated energy costs, increased freight costs, supply-chain delays, raw material shortages, increased staff costs, pent-up demand from precautionary savings and reduced opportunities to spend over the course of the pandemic, all lead to significant potential risks.

Global Composite PMI



Source: IHS Markit/JP Morgan

Commodity prices

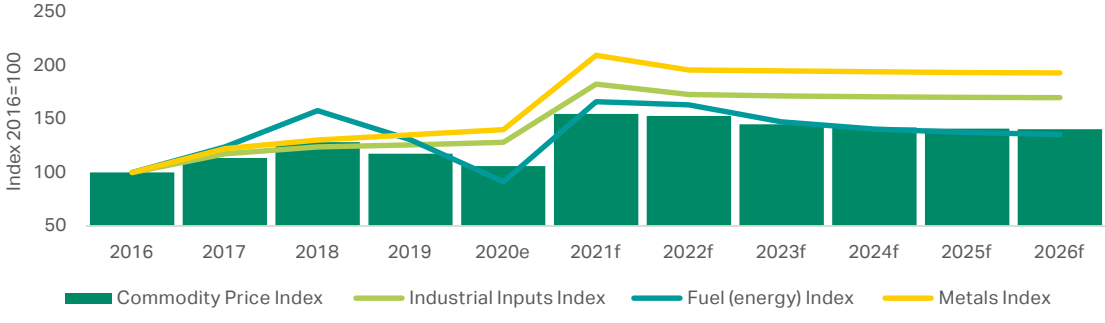
Many commodity prices rose sharply in 2021, including a significant number well above pre-pandemic levels. Q3 2021 saw key non-energy indexes of agriculture, fertilizers and precious metals at around 30 to 50 per cent higher than pre-pandemic levels, whilst metals and minerals were around 50 per cent greater.

Aside from the evident supply disruptions and uneven recovery faced post-pandemic, adverse weather also impacted many commodity markets. Most notably, conditions such as high summer temperatures, droughts and floods caused a ripple effect in overall commodity prices. High temperatures cause a greater demand for electricity, droughts impact agriculture and hydro-electricity supply whilst floods in certain areas disrupt the supply of coal and certain metals.

All of these factors have contributed to increased input prices for manufacturing and agricultural goods. They are also set to cause considerable inflationary pressures on markets, particularly for EMDEs who are facing high international food prices and energy costs

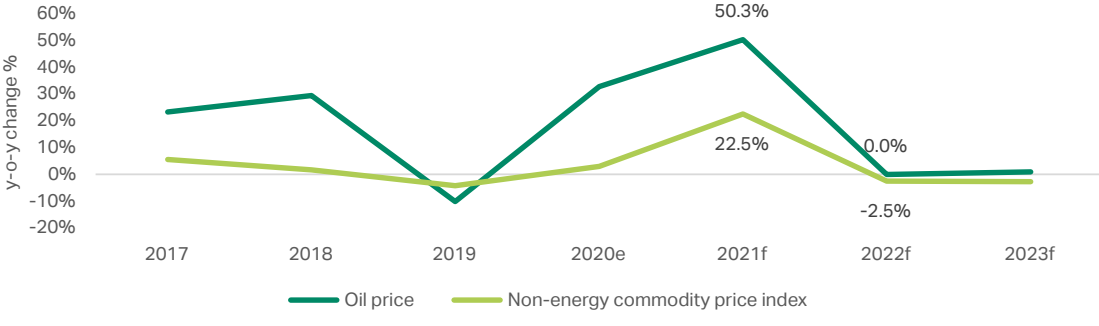
With regards to high food prices, the Food and Agriculture Organization (FAO) and the World Food Program (WFP) underline the challenges faced worldwide by food security risks—in 2020 more than 155 million people are already suffering famine or famine-like conditions and a further 41 million are at risk of falling into this category.

Commodity Price Indices



Source: World Bank Economic Prospects, June 2021

Growth in Commodity Prices



Source: World Bank Economic Prospects, June 2021

Energy

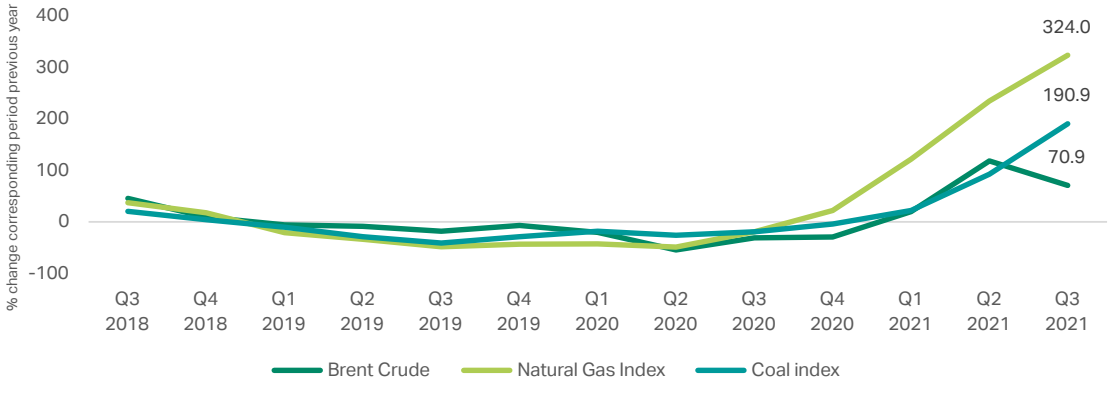
Energy prices surged in Q3 2021, particularly natural gas and coal reaching record highs. Looking at percentage increases against the same period compared to the previous year, the Q3 2021 natural gas prices have increased a staggering 324 per cent, with coal at 190 per cent and oil at 70.9 per cent respectively.

Overall, the volatility in the market this year has given further gravitas to how fluctuating weather patterns, attributable to climate change, are becoming a significant supply/demand risk to energy markets.

From a decarbonization perspective and transitioning to renewable energy sources, this period has caused many countries to rethink strategies considering the reliability of renewable energy and to reconsider backup energy supplies. A positive aspect of increased fossil fuel prices this year is that it has made the prospects of solar and wind power generation a much more palatable alternative, and if implementation is fast-tracked by countries it will reduce their dependency on volatile fossil fuel.

According to The World Bank's Commodities Markets Outlook October 2021, overall energy prices soared more than 80 per cent in 2021. Growth forecasts are somewhat subdued at two per cent for 2022, and in anticipation of continued robust demand and gradual production gains, before sharply falling in 2023 as supply considerably opens up.

Changes in energy prices



Source: IMF Primary Commodity Prices

Oil

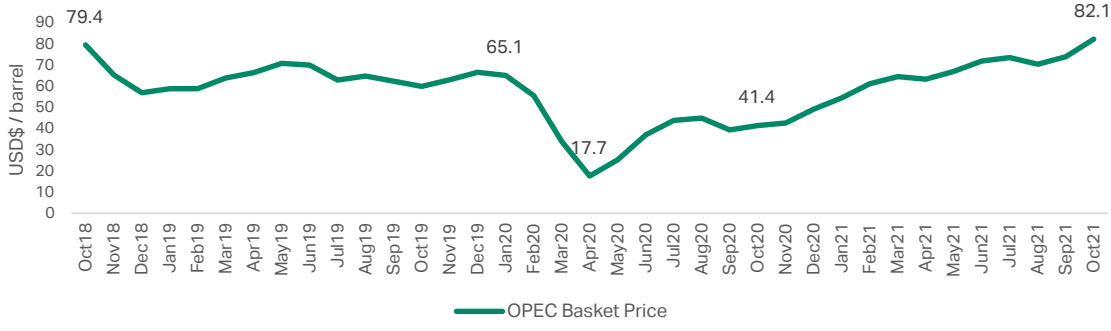
During the month of October 2021, the OPEC basket price reached $82 per barrel, rising above pre-pandemic levels and reaching a seven-year high.

With the OPEC+ ministers reaching an agreement in July 2021 to boost oil supply by a further two million barrels per day from August to December 2021, oil price increases were expected to cool off in Q4. Oil price increases during the year were buffeted by production disruptions in the US, alongside increased electricity demand for cooling and heating in light of adverse weather conditions.

According to The World Bank, oil prices are forecasted to average $74/bbl in 2022, up from a projected $70/bbl in 2021, before dropping to $65/bbl in 2023. Oil demand is expected to continue its recovery and reach its pre-pandemic level by the second half of 2022.

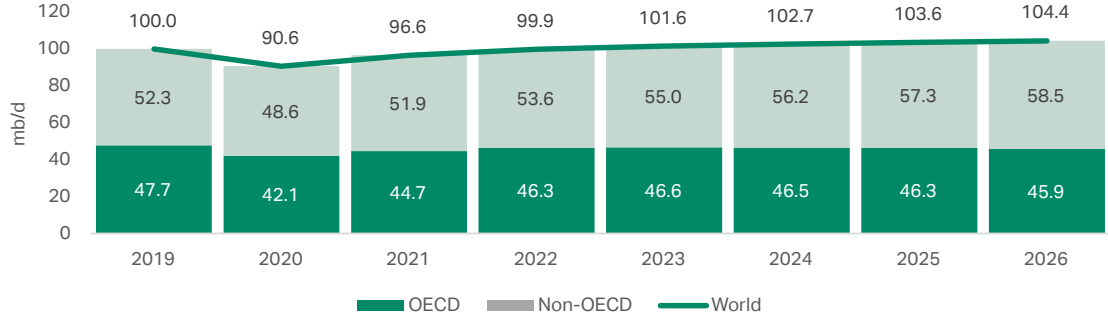
Upside risks to oil prices suggest that an increased substitution of crude oil over coal and natural gas for heating and electricity production means projections could be modest at this stage. Further outbreaks of coronavirus continue to be the predominant downside risk to oil demand as pandemic-imposed restrictions reduce consumption.

OPEC Basket Price



Source: OPEC

Medium - term oil demand



Source: OPEC 2021 World Oil Outlook 2045

Natural gas and coal

Key factors that are attributable to the surge of natural gas prices of 69 per cent and coal 44 per cent in Q3 2021, are seen in the economic recovery of China and its demand for fossil fuels for electricity generation. In addition, remarkably hot weather periods which increased electricity demand for cooling and reduced renewable energy production is seen in several countries due to low wind speeds and droughts.

Metals

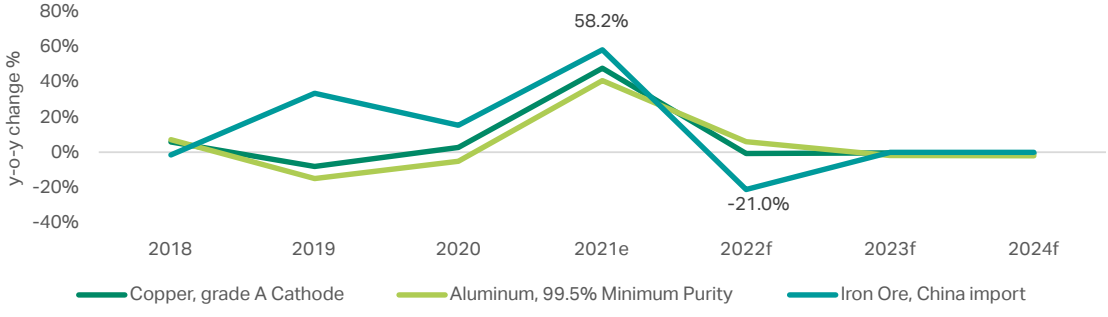
The high volatility of metal prices during 2021 can be attributed to production shortages and supply disruptions. The pent-up increased a demand for machinery, manufacturing and construction following the easing of the pandemic restrictions.

Iron ore, in particular, has been on an upward trajectory since late 2018, due to the supply side reforms implemented in China to decrease surplus steel capacity and increase demand and prices. Adding to that, other major iron ore producing countries, such as Brazil, have been unable to meet stated targets due to the pandemic, extreme weather, unexpected maintenance and mining accidents, and Australia's miners have been unable to offset the deficit caused by lower volumes from Brazil.

These factors have all attributed to the IMF forecasted metal price increase of 48 per cent in 2021. Key risks associated with the metal price outlook are the energy-related supply disruptions, China's demand requirements and the global challenge of decarbonization from extraction to the final product. China acquires 50 per cent of the metals produced across the globe—they are the largest buyer of copper and remain the world's largest producer and consumer of steel

The outlook for metal prices in 2022 is that they are forecasted to fall by five per cent as the global recovery improves and peaks in metal prices stabilize following averaged price increases over 2021 in iron ore by 58 per cent, copper by 48 per cent and aluminium by 41 per cent in comparison to the previous year.

Changes in metal prices



Source: IMF, World Economic Outlook Database, October 2021

Decarbonization

Commodity prices globally are facing increasing price pressures to meet decarbonization targets. This was recently bolstered during the COP26 2021 summit and is in keeping with the Paris Agreement 2015.

In September, 2020 China also announced its commitment to becoming carbon-neutral by 2060 and it is becoming increasingly evident that every party in the supply chain is paying closer attention to decarbonization.

Further encouraging signs in meeting these targets can be seen through the financial sector in socially responsible investors. It is rightfully becoming best practice for companies to focus on Environment, Social and Governance (ESG) criteria and investors are utilizing this as part of their considerations as to whether companies are worth investing in. Increasingly, businesses are being obliged to conscientiously review their O&M, machinery and power sources and then innovate to create technological breakthroughs to deliver these targets.

UN CLIMATE CHANGE CONFERENCE UK 2021

IN PARTNERSHIP WITH ITALY

Goal: Secure net-zero by the middle of the century and keep 1.5 degrees within reach.

Around the world, countries are being asked to come forward with ambitious 2030 emissions reductions targets that align with reaching net-zero by the middle of the century.

To deliver on these stretching targets, countries will need to:

- Accelerate the phase-out of coal.
- Curtail deforestation.
- Speed up the switch to electric vehicles.
- Encourage investment in renewables.

Global economic risks

The following are major risks identified for 2022 and beyond.

The coronavirus pandemic
During 2020, the pandemic caused a political and economic impact worldwide and is a continual risk moving into 2022. The pandemic heightened vulnerability for emerging markets and may continue to impact commodity markets and oil price. Latin-America was one of the least prepared regions to deal with the virus and they struggled to contain the outbreak across the region. The economies were already unsettled due to slow economic growth, low-quality public services and vulnerable middle classes expecting increased state spending on social services.

South Asia tensions
Tensions between India-China and the South China Sea remain a risk across military, diplomatic and technology fronts.

UK-EU Brexit
Brexit remains an ongoing risk for the UK economy following the transition period from the beginning of January 2021 and will remain so during 2022. Results from the negotiations will outline and detail how business procedures will operate.

US/China tension
Trade tension between the US and China will remain a risk even with a new President. Competition is expected to rise within the technology sector with restrictions placed on tech exports to and from China and exposed supply chains..

Digital cyberattacks
As new technologies are set to reshape economies with a drive towards autonomous vehicles and the use of drones, artificial intelligence alone is expected to boost global growth by 14 per cent by 2030. The digital world will be vulnerable to cyberattacks, as already seen with critical infrastructure (energy, healthcare and transportation) and geopolitical and economic uncertainties due to a lack of governance.

Adverse weather/climate change
Extreme weather caused by climate change will urge governments to make commitments in reducing their countries emissions. An emphasis will be placed on oil, gas firms, airlines, car manufacturers and the food industry as this will remain a prevailing risk in 2021 and beyond.

Biodiversity loss
Biodiversity loss is caused by climate change, pollution, deforestation and habitat loss. This risk threatens global ecosystems, affects livelihoods, food supplies, income and disease.

Natural disaster
Natural disasters can be a preventable risk, and solutions such as reforestation, education, technology governance and economic support could help mitigate and reduce the risks caused from global warming, pollution and mining.

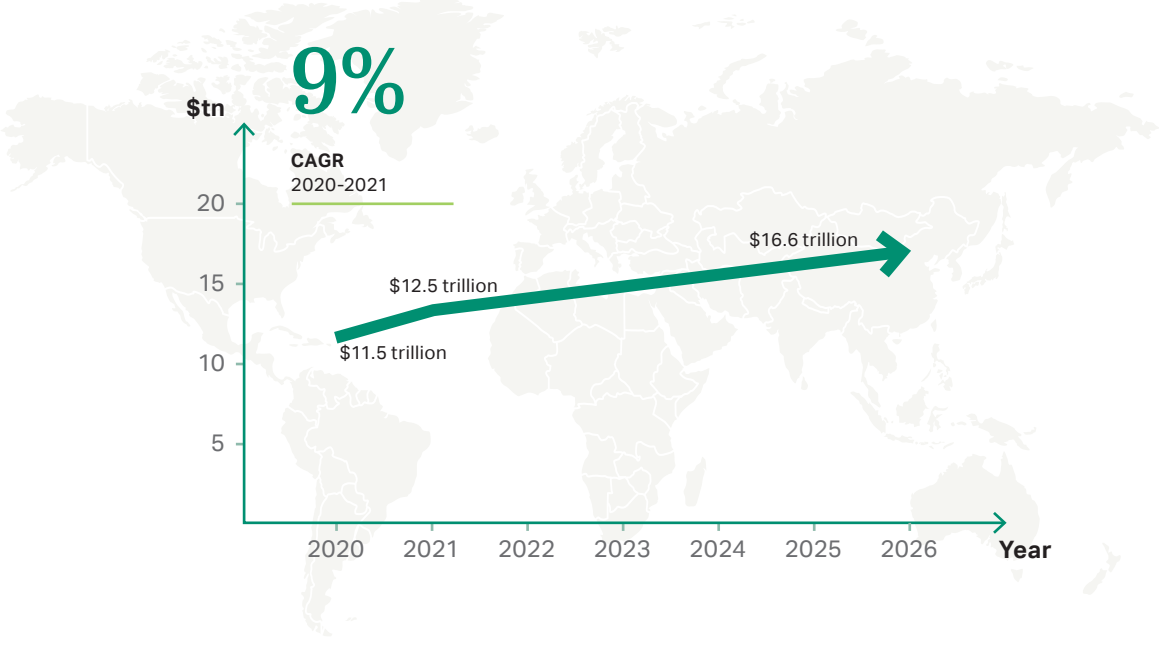
Global construction prospects

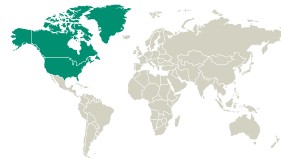
This forecast review is for a period covering 2021-2026, analyzing anticipated construction growth during this time.

The global construction market scale is expected to increase from circa $11.5 trillion (2020) to $12.5 trillion (2021) at a compound annual growth rate (CAGR) of 9 per cent, reaching $16.6 trillion by 2025, according to Business Wire.

The RICS Q3 2021 Global Construction Monitor also indicates that construction activity is still on the rise, however, material shortages and escalating costs are hampering growth. ICT and energy sectors are expected to remain as the fastest growing areas.

The global construction industry is expected to be a key catalyst for economic recovery from the coronavirus, propelled by government stimulus, infrastructure spending, refurbishment and maintenance and residential construction requirements. Construction businesses are reacting across the globe to accelerate digital adoption and create innovative solutions to ease cumbersome industry norms and increase efficiencies to further fast-track recovery.





North America

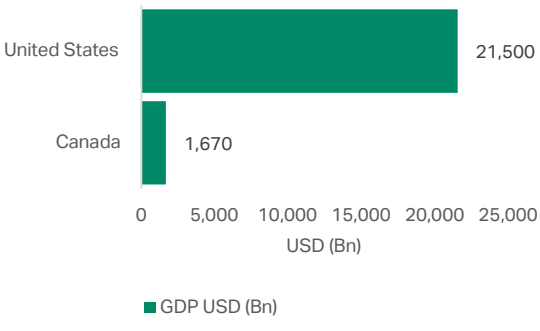
The construction industry in North America's was estimated to be circa USD two trillion in 2020 and is forecasted to record a CAGR of 5.2 per cent between 2021-2026, according to Mordor Intelligence.

North America's construction sectors are being propelled by strong residential growth, which has been somewhat unobstructed by lockdown restrictions. The demand for new affordable suburban homes remains strong, and growth is notably concentrated on single-family homes. Previously, demand has been held back by a lack of affordable housing, especially among young adults looking to join the property ladder. Non-residential growth is expected to be restrained as the US transitions out of lockdown, with many areas such as retail, office space and hotels all continuing to be slow moving, according to Oxford Economics 'Future of Construction Report' (2021).

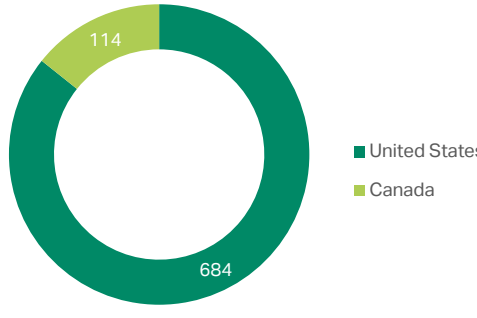
Moving forward, the American Jobs Plan (AJP) is set to boost US infrastructure construction with plans for rebuilding highways and railroads, repairs to old bridges and the boring of new tunnels. AJP's spending plans are anticipated to have a significant proportion focused on the development of "green solutions", including interconnecting cities through high-speed rail, creating new mass transit systems within urban centres and developing new public transport infrastructure. Another key area of the infrastructure spend, and in support of the US transitioning away from internal combustion engine vehicles, will be the expansion of EV charging networks throughout the country.

Canada's forecast for the construction industry was expected to increase by 2.5 per cent in 2021, following the launch of the government's "Growth Plan" in October 2020. This plan aimed to invest USD 7.6 billion over the next three years to create 60,000 jobs to support the recovery from the coronavirus pandemic. The spending will include USD two billion for clean energy, USD 1.6 billion for building retrofits and USD 1.5 billion for electric buses and charging infrastructure, according to Business Wire. Additionally, the government announced spending plans in February 2021 to inject USD 12 billion in public transport projects over the next eight years.

North America GDP



GDP from construction USD (Bn)



Source: IMF, World Economic Outlook Database, October 2021

Latin and South America

In 2021, economic activity was projected to grow at 5.2 per cent; a rebound insufficient to return GDP to 2019 levels after the deep recession of 2020. Growth will be supported by moderate progress in the rollout of the coronavirus vaccine, reduced mobility restrictions and improved external economic conditions, according to World Bank, Global Economic Prospects (2021).

Income losses per capita are expected to extend in to 2022, particularly for small island economies in the Caribbean. However, robust growth and fiscal support in the US could provide some relief to forecasted downsides.

Key downside risks for Latin and South America include increases in coronavirus cases, sluggish vaccine rollouts,adverse market reactions and disruptions from social unrest, as well as those related to climate change and natural disasters.

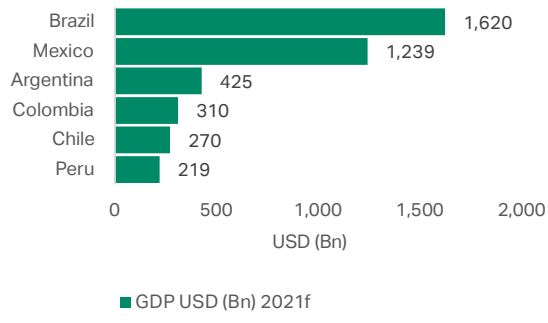
According to Oxford Economics' Future of Construction Report (2021), immediately prior to the coronavirus pandemic, the Brazilian construction sector was on the brink of recovering from a five-year depression.

Recovery and growth are expected in 2022, with construction growth forecasted at around 3 per cent, but the forecast over the next ten years continues to be far below the vast growth experienced in the 2000's and early 2010's. There is continued focus from the government to attract foreign direct investment (FDI), which will target manufacturing to support the non-residential sector, particularly auto manufacturing, and growth in tourism is expected to further boost construction of hotels and attractions.

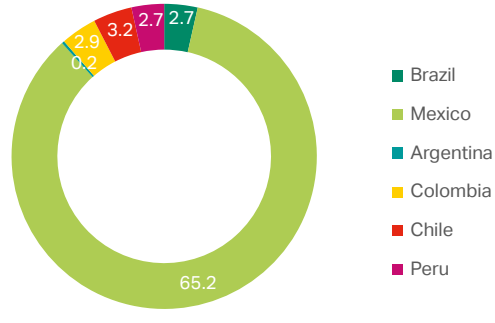
Meanwhile in Mexico, relationships with the US and Canada provide the most economic opportunities. The automotive sector continues to be critical for the non-residential construction market, with further opportunities available regarding manufacturing and the integration of supply chains with the US. As for residential construction, strong population growth and enhanced incomes supported by increased migration, will all provide a boost in demand for housing stock.

In Chile, civil engineering is the leading construction sector due to its vast mining sector, most notably, copper mining. With the considerable increase in copper demand because of the electric revolution and significant price increases, major investments are being made in increasing the capacity of copper mines across the country.

Latin and South America GDP



GDP from Construction USD (Bn)



Source: IMF, World Economic Outlook Database, October 2021

Europe

Construction in Europe rebounded in 2021 from the decline in 2020, boosted by financial support from the EU. The construction industry saw a 1.5 per cent increase in 2021, following a 6.2 per cent drop in 2020, with the 27 member states benefiting from a €2.018 trillion stimulus package introduced in response to the economic damage caused by the pandemic.

The regional economy was projected to grow 3.9 per cent in 2021, with an improved external demand and higher industrial commodity prices offsetting the negative impact of new coronavirus cases.

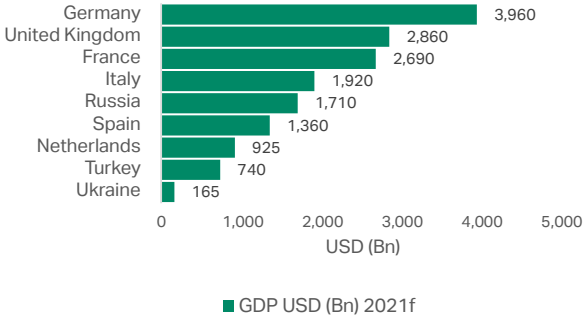
According to the World Bank, Global Economic Prospects (2021), growth in 2022 is expected to remain at 3.9 per cent, as the recovery in domestic demand gains traction. However, the regional outlook still remains uncertain, with uneven vaccine rollouts and the withdrawal of macroeconomic support measures slowing regional recovery. With the tightening of external financing conditions, growth may be further impeded if the pandemic prolongs, or if political tensions rise further.

Of the €2.018 trillion announced in the EU's 2021-2027 long-term budget, around €807 billion has been allocated to the Next Generation EU (NGEU) fund in the form of loans and grants between 2021-2023. A key aim of the fund is to support the EU's target of reaching climate neutrality by 2050.

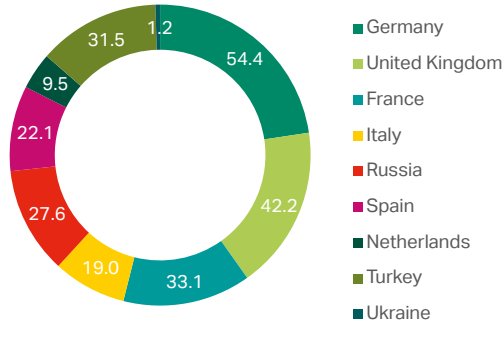
With particular focus on greener infrastructure projects, digital transformation, EV recharging networks and investments in renovation of older buildings to become more energy efficient.

Generally, the construction industry's strength is coming in the form of housing projects, while overall civil engineering works have reported a modest increase. However, the cost of materials is increasing at a record rate, putting pressure on builders' overall profitability moving forward.

Europe GDP



GDP from Construction USD (Bn)



Source: IMF, World Economic Outlook Database, October 2021

Africa

Although Africa's overall growth is expected to be moderate across its 54 nations, it remains one of the fastest growing continents. Countries such as Ethiopia, Ghana and Côte d'Ivoire are three of the fastest growing economies globally in terms of increased GDP. Africa's growth is further helped by several East African countries contributing collectively through increased exports and cross-border trade to grow the region's economy.

In 2020, Africa's construction projects were estimated to be worth circa USD 400 billion, with the industry expecting to register a CAGR of 7.4 per cent from 2021-2026, according to Mordor Intelligence.

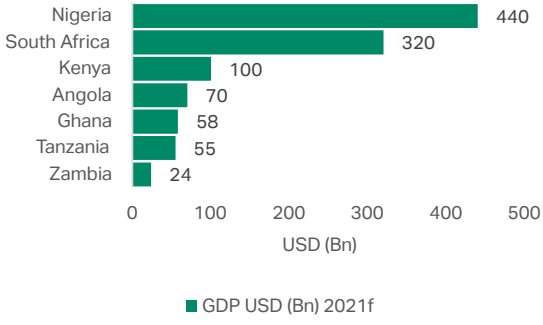
Growth in residential, commercial, industrial and institutional construction sectors is expected to remain subdued due to the ongoing impacts of the coronavirus pandemic. Short-term investments are expected to be driven by government spending in the infrastructure sector, with the overall long-term outlook continuing to remain positive due to the attractiveness of Africa for its foreign direct investment.

With Africa continuing to grow, there is a steady increase of larger infrastructure and construction projects coming to market for the needs of over 1.2 billion people, which is expected to provide further opportunities for investment and service providers for 2022 and beyond. The key focus areas will be the diversification of the economy, Public Private Partnership (PPP) projects, and the development of new infrastructure to meet the needs of its fast-growing population.

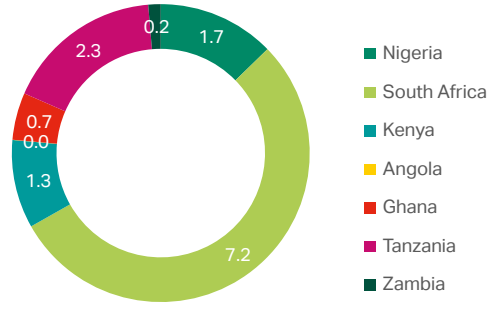
In 2022, growth is expected from the strengthening of global activity, improved international control of the coronavirus pandemic and strong domestic activity from agricultural commodity exporters. However, recovery is expected to remain fragile due to the slow pace of vaccinations in the region. Furthermore, due to the pandemic, tens of millions are estimated to have fallen into extreme poverty.

Other challenges include further food price increases, which could worsen food insecurity, conflicts and rising tensions and ongoing logistical impediments.

Africa GDP



GDP from Construction USD$ Bn



Source: IMF, World Economic Outlook Database, October 2021

Asia

Growth was expected to accelerate to 7.7 per cent in 2021, mainly reflecting China's strong rebound form the pandemic downturn. It is estimated that output in two thirds of the region will continue to remain below pre-pandemic levels until 2022, according to the World Bank, Global Economic Prospects (2021).

Potential growth is expected to remain dampened, particularly to the economies that have experienced extended outbreaks of the virus and prolonged shutdowns to global trade and tourism.

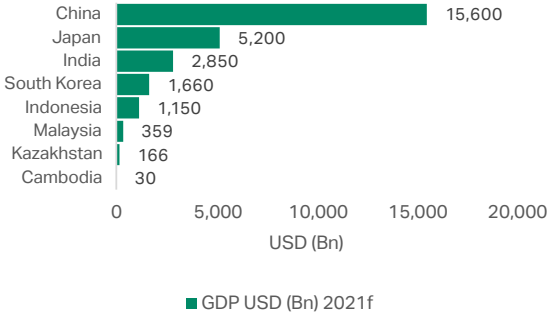
China continues to be the largest construction market in the world and its core demand for materials is recognised as a key contributor to the increases of global commodities prices. Aside from the challenges of the pandemic and increased commodity prices, the financial viability of the country's markets have dampened the overall growth outlook, as the liquidity crisis of one of its largest property developers, continues to unfold.

Construction and infrastructure remain a key economic driver for ASEAN countries, which have been reported to accelerate the development of infrastructure, affordable housing and sustainable, green projects following the recovery from the pandemic.

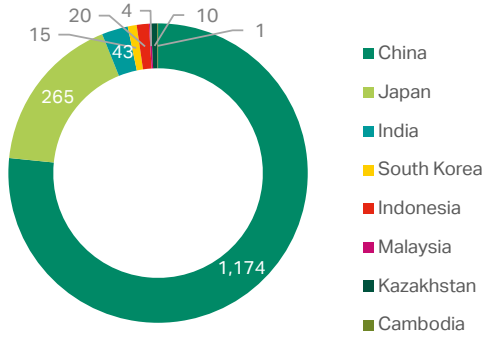
Risks to the region's recovery include, delayed vaccination programmes, the potential of repeated large-scale coronavirus outbreaks, increasing financial pressures caused by increased levels of debt, declining investment due to the risks and barriers associated with operating in the region and eroding human capital. Furthermore, the threat of disruptions from natural disasters is a constant risk for many countries, particularly island economies.

Despite the risks known across Asia, the longer-term growth projection remains on a positive trend.

Asia GDP



GDP from Construction USD$ Bn



Source: IMF, World Economic Outlook Database, October 2021

Australasia

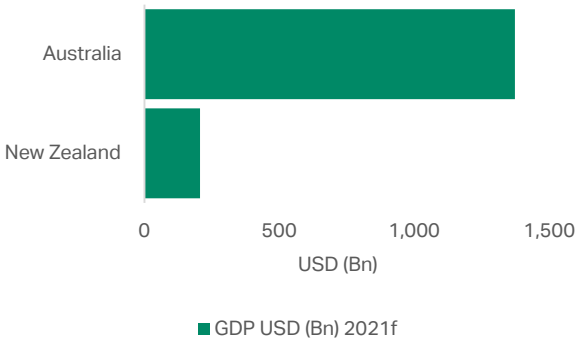
The Australian building and construction market is bouncing back, according to the Australian Construction Industry Forum. Growth is set to exceed expectations, attributed to Australia's ability to control the spread of coronavirus through an extensive range of policy measures designed to provide rapid recovery.

In 2021, the construction market was forecast to grow by 2.7 per cent, which was expected to reach $243 billion in building and construction work. The building of new houses will see an impressive 10 per cent growth during the year, and this will be driven by an accelerated house demand.

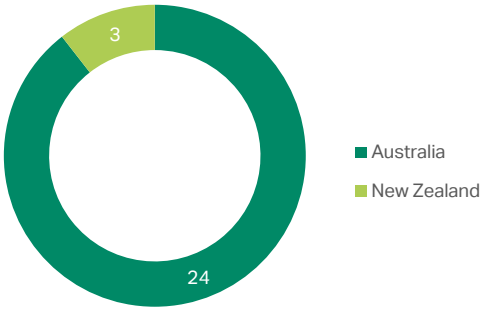
In addition, this will also be supported by record low interest rates, government support programs, such as HomeBuilder, and an improving opportunity for sustained employment growth.

Spending on infrastructure across areas such as electricity supply, water and railways, are expected to benefit from increased infrastructure delivery programs from the governments, with increased government spending and investment in social infrastructure and essential services.

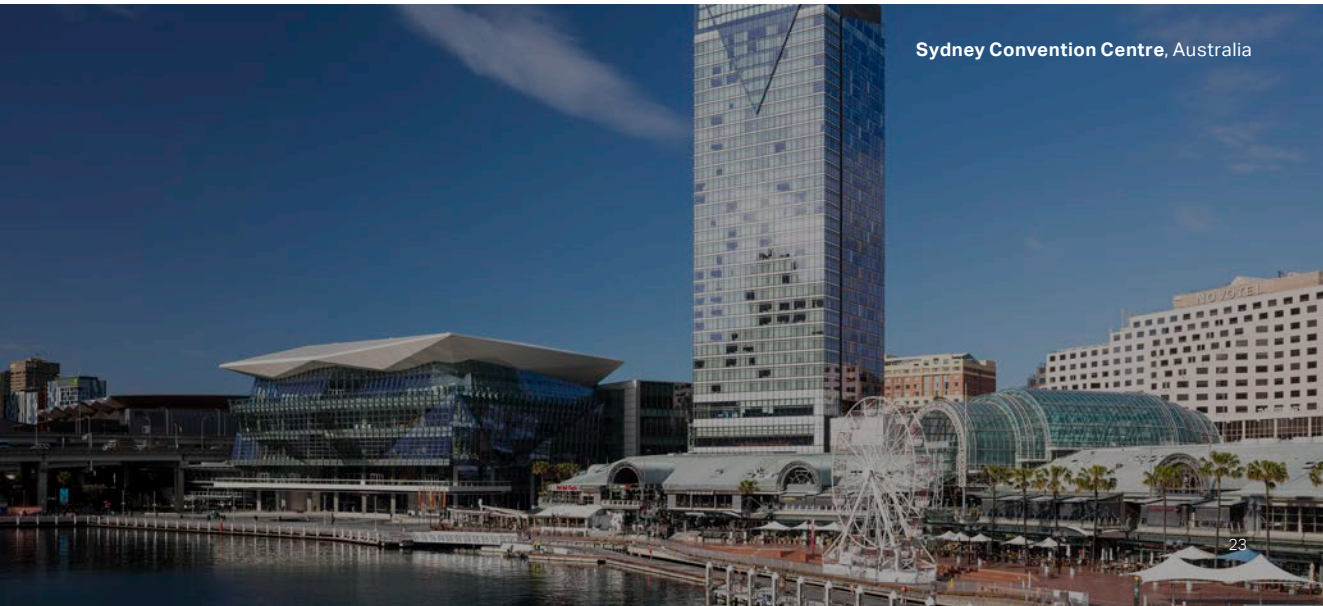
Australasia GDP



GDP from Construction USD (Bn)



Source: IMF, World Economic Outlook Database, October 2021



Sydney Convention Centre, Australia

MENA economic review

As of Q3 2021, the IMF forecasted that the Middle East and North Africa (MENA) region's GDP was set to grow by 4.1 per cent in 2021. This is a significant increase from the contracted 3.2 per cent reported in 2020, and somewhat exaggerated compared to the figures reported by the World Bank who estimated growth at 2.8 per cent for 2021. This disparity of forecasted figures further highlights the uncertainty and projected uneven recovery across markets and countries.

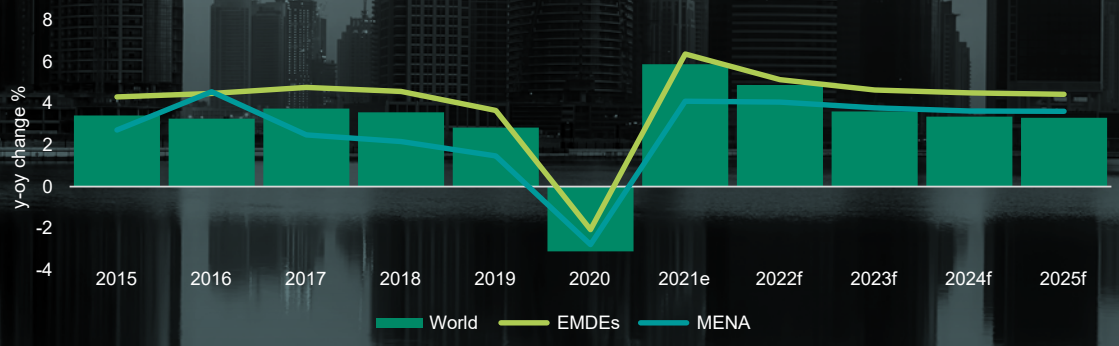
The Middle East alone accounts for approximately 48 per cent of the world's proven reserves of crude oil. Whilst enduring high oil prices, this has created fiscal surpluses and supported economic recovery for those oil exporting countries (e.g Saudi Arabia, UAE, Kuwait). In addition, this also widens the deficit and continues to impose substantial economic burdens to the oil importing countries (e.g. Egypt, Jordan, Lebanon).

During 2022, oil prices are expected to stabilize and somewhat reduce from those peaks seen in 2021. This will also be supported by rising production outputs from OPEC+ countries and in line with the relaxations of restrictions globally.

The disparity and pace of recovery for the MENA countries will be heavily reliant on oil prices. Key risks remain in terms of OPEC+ as they continue to uphold their 2022 plans for increased production and the continuation of coronavirus restrictions to international and regional markets.

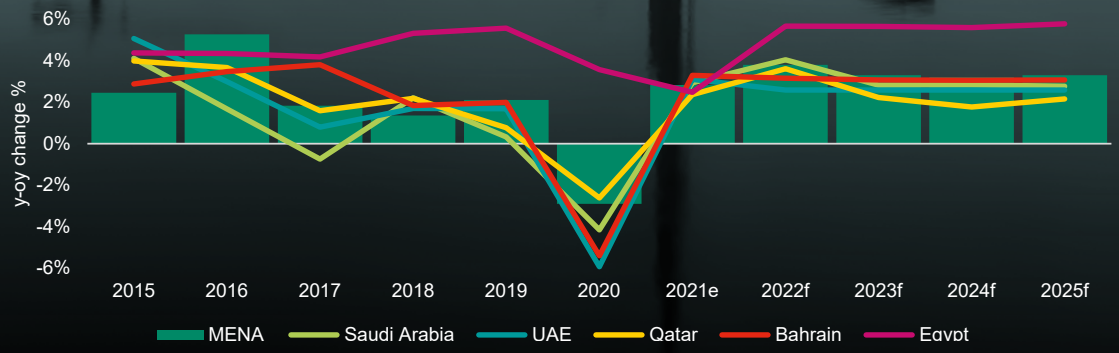
The graph on the adjacent page shows the MENA GDP growth rate in comparison to emerging markets and developing economies. This is also tracked against the overall world economy from 2015 and forecasted to 2025. According to the IMF, the MENA region's GDP is expected to maintain its growth levels between 2022 and 2025.

World, EMDEs and MENA, GDP growth at constant prices



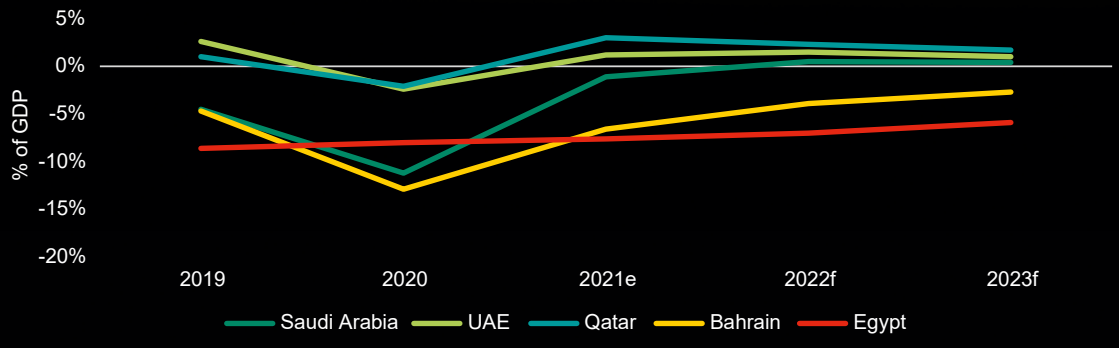
Source: IMF, World Economic Outlook Database, October 2021

Selected MENA countries, GDP growth at constant prices



Source: IMF, World Economic Outlook Database, October 2021

Budget balance % GDP for selected MENA countries



Source: Haver Analytics, Emirates NBAD Research July 2021

2021 MENA country statistics

Below is a reference to key data for MENA countries in 2021. It presents statistical growth and forecasts for 2021 and, through some instances, to the end of review period in 2026. The table identifies the country's GDP value, import and exports against GDP, population growth and, where possible, construction market data.

	Algeria	Bahrain	Egypt	Iran	Iraq	Jordan	Kuwait	Oman	Qatar	Saudi Arabia	UAE
Land area, '000 km² (1)	2,381.7	0.8	995.5	1,628.8	434.1	88.8	17.8	309.5	11.6	2,149.7	71.0
Capital city	Algiers	Manama	Cairo	Tehran	Baghdad	Amman	Kuwait	Muscat	Doha	Riyadh	Abu Dhabi
Population, million, 2021f (2)	45.0	1.5	102.9	85.0	41.2	10.3	4.7	4.6	2.7	35.5	9.4
Population growth, CAGR 2021-2026 (CAGR %) (2)	1.6	2.1	2.1	1.0	2.7	0.7	1.7	3.3	2.1	2.1	1.5
GDP, USD, billion, current, 2021f (2)	163.8	39.1	396.3	1,081.4	201.5	45.3	132.3	80.6	169.2	842.6	410.2
Real GDP growth (2020-2021), % (2)	3.4	2.4	3.3	2.5	3.6	2.0	0.9	2.5	1.9	2.8	2.2
Real GDP growth, 2021-2026 pa forecast (2)	0.1	0.2	0.3	0.2	0.3	0.2	0.1	0.2	0.2	0.2	0.2
GDP/Capita (PPP), USD, 2021f (2)	3,638	26,294	3,852	12,725	4,893	4,394	27,927	17,633	61,791	23,762	43,538
Net lending/ borrowing, % (2)	-9.6	-3.2	1.3	-4.6	-0.5	-3.7	-13.4	-1.5	4.7	-2.8	0.0
Volume of imports of goods & services, % of GDP (2)	1.9	-12.6	-7.5	7.1	-	1.7	12.6	-11.2	1.0	8.2	1.1
Volume of exports of goods & services, % of GDP (2)	0.8	-17.2	-11.2	13.0	-	5.3	-1.0	-16.1	2.1	10.5	2.2
Account balance, USD, billion, current (2)	-12.5	-1.1	-15.4	13.9	12.4	-4.0	20.5	-4.6	13.9	32.6	39.6
Unemployment rate, % of total labour force (2)	14.1	3.9	9.3	10.0	-	-	-	-	-	-	-

Source: (1) World Bank (2) IMF

MENA economic challenges and risks

The MENA region will continue to face specific challenges in 2022, especially as governments continue to manage the impact of the pandemic. Factors such as political instability, extreme unemployment, economic uncertainty (or economic collapse in the case of Lebanon), pandemic relief disparity and the ongoing conflicts in countries such as Syria and Yemen, all remain challenges to the stability and recovery of the region. The MENA region is noted as being especially vulnerable and requires swift and effective reforms to prevent further financial economic impacts and expedite recovery into 2022.
The key risks associated with the MENA region include:

1

Pandemics
New viruses/ variants

2

Governments
Institutional/ social fragility and corruption

3

Climate change
Extreme weather/ rising sea levels/ floods/droughts

4

Unemployment
And under-employment, especially for youths and females

5

Oil prices
Exporting and importing reliance

6

Conflicts
Violence, protests and social unrest

7

Human capital
Education/ skills/gaps

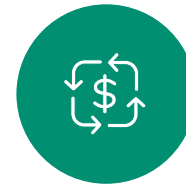
8

Cyber-attacks
Disruption of operations or theft of data/ money

9

Food security including water

10



International ties and trade tensions

MENA construction market review

The MENA region has around $4.1 trillion worth of construction projects planned or in the execution phase, according to MEED. In addition, the region remains abundant with prospects for construction-related businesses, despite the global economic downturn.

The ongoing driving force behind the MENA region's construction resilience is the need to diversify and develop their economies to meet the demands of its rapidly growing population, and overall, lessen its economic reliance on finite and economically volatile fossil fuels.

The pipeline of projects regionally are estimated at around $3.3 trillion, with the GCC equating to over two thirds of this market value. The largest segment of construction projects remain in building and real estate, investments in private property, including the development of schools, hospitals and social infrastructure to advance existing and growing populations.

Oil and gas segments continue to invest heavily in upstream investigation and construction to increase capacity, and likewise, in downstream activities to produce higher value outputs. Increased demand for power and water are additionally increasing investments with the added incentive to diversify to clean energy and increase energy security.

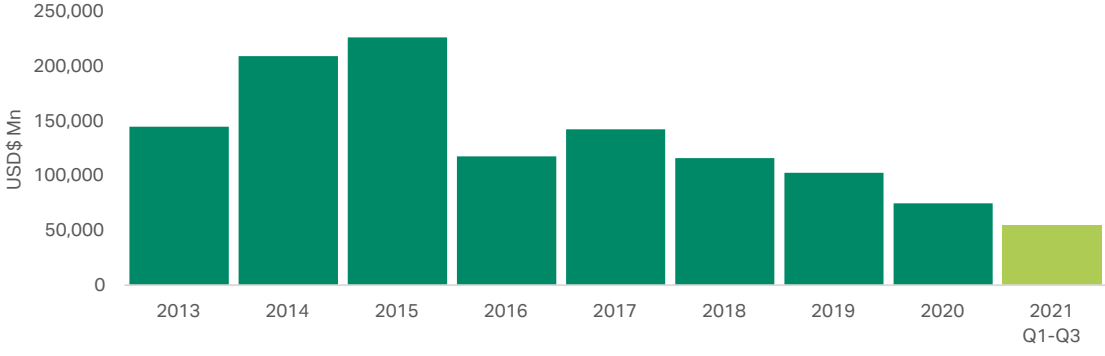
Cities are set to continue investment in infrastructure upgrades to increase connectivity, increase transportation capacity and meet smart city demands.

The overall outlook for the MENA region's construction market is set to be optimistic over the next two years, bolstered by the GCC's improving fiscal situation as oil prices remain buoyant and output caps are eased.

According to MEED, awarded projects for the MENA region up to the end of Q3 2021 remained subdued and at similar level to 2020. However, early indicators in Q4 2021 showed strong signs of recovery in the region, with $8.4bn of contracts awarded in October and $9.8bn awarded in November, taking the logged value of awarded contracts to $73.2bn as of end- November 2021.

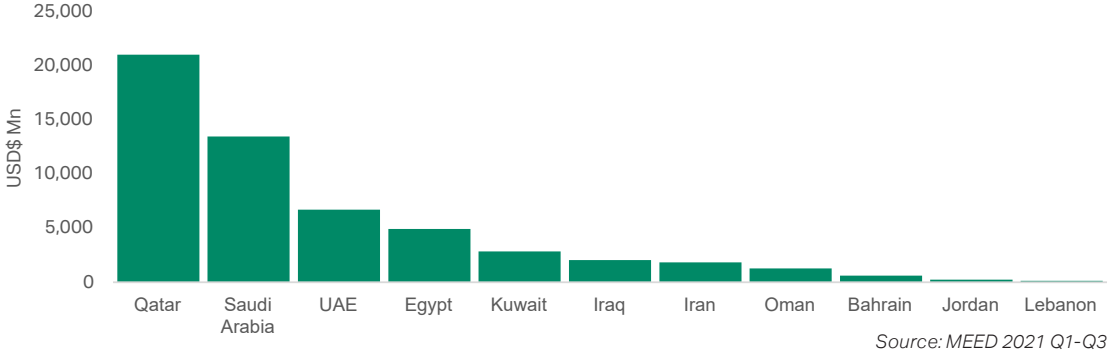
Considering the full year, contract awards for 2020 was $74.8bn, 2021 was set to exceed and continue to grow into 2022. This expected growth is bolstered by Saudi Arabia's commitment to Vision 2030 and its giga projects, Egypt's continued commitment to its infrastructure ambitions, increased business sentiment following UAE's Expo 2020, continued buoyant oil prices, and the overall effect of the global economic recovery.

MENA projects awarded yearly



Source: MEED 2021 Q1-Q3

MENA projects awarded by country 2021



Source: MEED 2021 Q1-Q3

In focus - the Kingdom of Saudi Arabia

The Kingdom of Saudi Arabia's spending budget for 2022 has been approved at USD 255 billion and is expected to post its first budget surplus in nearly a decade, and it looks to stabilize public spending despite this year's surge in oil prices.

After an expected fiscal deficit of 2.7 per cent of GDP in 2021, the Kingdom estimates that it will achieve a surplus of USD 23.98 billion or 2.5 per cent of GDP in 2022 - its first surplus since it went into a deficit after oil prices crashed in 2014.

KSA is set to contribute to the largest volume of new construction project opportunities in the MENA region in 2022. It is estimated that over USD one trillion of construction and transport projects are currently planned in the kingdom, and around USD 58 billion of construction contracts are currently in tender.

The major catalyst for this investment is KSA's Vision 2030. This strategy outlines economic and financial reforms and looks to utilise the country's investment power to create a thriving, diverse and sustainable economy for its population. Leading this drive is the Public Investment Fund (PIF), the Kingdom's sovereign wealth fund, which has disclosed plans to invest up to USD 266 billion into new projects by 2025.

Some of the key projects paving the way for the Kingdom's future and Vision 2030 are:

NEOM: At the center of Saudi Arabia's Vision 2030 program, NEOM is a new futuristic mega city located in northwest Saudi Arabia, on the Red Sea coast, with a total estimated value of USD 500 billion. NEOM is expected to host a population of more than one million and is set to be a hub for innovation and a sustainable ecosystem for working and living.

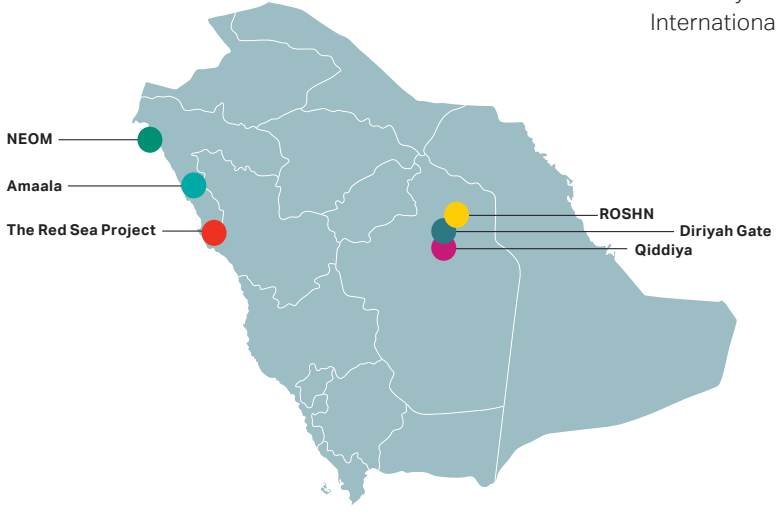
The Red Sea Project: Set across 28,000km^2 and nine islands, this giga-project is underway. Consisting of 50 hotels (circa 8,000 keys), a new airport and leisure and lifestyle facilities served by 75km of new roads.

AMAALA: An ultra-luxury tourism project, spanning over 4,100km^2 and will include 2,500 hotel rooms, estate homes and 800 villas. The target is for an operational zero-carbon footprint with the project tracking more than 15 sustainability criteria.

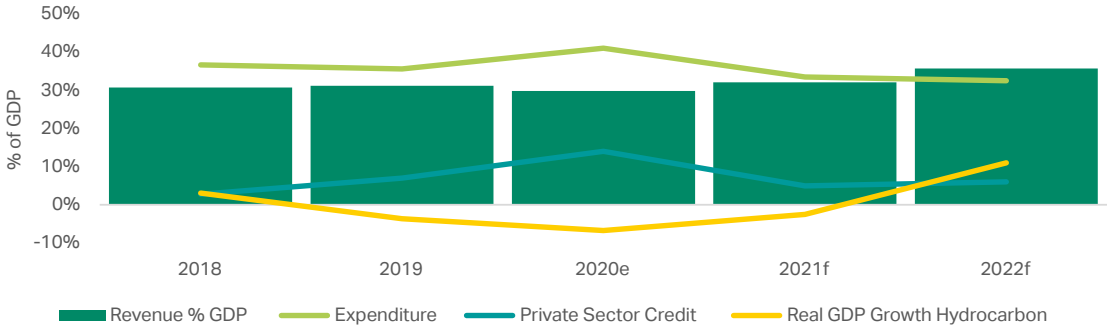
Diriyah Gate: A USD 50 billion mixed-use historic, culture and lifestyle destination west of Riyadh. The project's intent is to showcase Saudi Arabia's 300+ year history through a set of heritage, hospitality, education, retail and dining experiences for residents, tourists and frequent visitors.

Qiddiya: An entertainment, sports and arts hub, located in southwest Riyadh. Qiddiya is set to include a Six Flags theme parks, FIA grade one racetrack, a Jack Nicolas golf course and several arts and cultural centers.

ROSHN: Around USD 90 billion has been assigned to create large-scale modern and integrated communities for Saudi nationals in nine cities across four regions in KSA, with a goal to increase the rate of home ownership to 70 per cent. The first contract to be signed is a 3,000-home community, including associated infrastructure, in North Riyadh close to King Khalid International Airport.

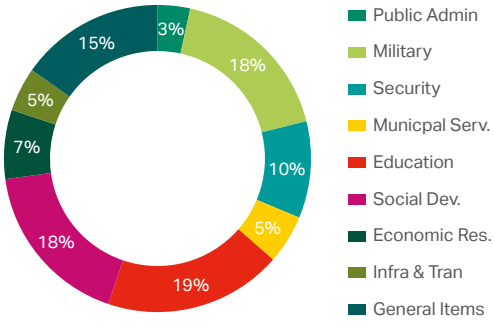


Saudi Arabia key economic forecasts



Source: Haver Analytics, Emirates NBD Research July 2021

Saudi Arabia budget expenditure 2021



Source: Saudi Arabia Budget MoF

NEOM, Saudi Arabia

MENA construction trends and prospects

Green environment and technology:
In parallel to other regions, carbon footprints and fighting climate change will present new opportunities on the horizon. Especially as the overall construction industry is a key benefactor in the matter of environmental conservation.

Safety:
Safety is a focal point on all projects for both construction workers and the public. Revised safety regulations will soon be applied to construction equipment and machinery on future construction projects by contractors and developers alike. With the focus on reducing the spread of coronavirus still present as we head into 2022, maintaining newly adopted safety protocols are essential in ensuring construction sites remain operational.

Supply chain diversification:
As a lesson learned from the start of the pandemic, contractors had little choice but to pay premium prices for materials and alternative suppliers due to the disruptions caused. 2022 will see stakeholders in the construction industry re-evaluating and streamlining current procurement relationships. This may come with a risk in coordination, however, the industry envisages cost efficiencies through diversification.

Living materials:
There is a new trend around the development of living materials being applied to construction, such as when biological materials are used to support concrete construction, insulation and flooring such as 'bacteria' and 'fungi' in replacement for far less sustainable materials.

3D printing:
This has already taken off within the construction industry and looks to grow at a record pace in 2022.

Remote technology:
As a rising trend through 2021, assisted by the issue of remote working, remote technologies help to mitigate problems with administrative and building construction works. An example of this is how the use of drones within the construction industry is on the rise, assisting in the quantification process and identifying and mitigating safety hazards.

Infrastructure:
This will remain in the spotlight across MENA, with countries highlighting the service market through stimulus packages, which will also aid the construction recovery in 2022.

Innovation and modernization:
This is a rising trend focusing on the manufacturing of construction building equipment and materials, with a drive for greater quality of work and cost-effective solutions. New innovative IT delivery will look at evolving the construction industry; improving general service delivery and modernizing buildings, with a fresh safety viewpoint.

Source: Zawya and Levelset

MENA construction—strengths, weaknesses, opportunities and threats

Post-pandemic, and leading into 2022, a new normal is expected in the region with an opportunity for transparency, trust and a collaborative approach within supply chains and between stakeholders.

The change is anticipated to see greater cashflow management and improvements to contractual terms and conditions.

Looking at the key strengths, weaknesses, opportunities and threats for construction in the region, it is clear there are many strengths and opportunities set to support the buoyancy and growth of the MENA construction market moving into 2022. However, this is expected to be disproportionate across countries.

Strengths

- Capability of delivering complex and bespoke structures
- Diversification and government incentive to invest
- Creating and providing employment opportunities
- Supporting local talent and industries
- Economic value creation
- International input/supply/ location/ability to import
- Construction speed
- Reduced bureaucracy
- Cheaper cost of labor

Weaknesses

- Payment delays
- Procurement timescales and awarding contracts before design completion
- Carbon emission and environmental impact
- Missed opportunities for lessons learnt from project to project
- Resources, transient population/talent gap
- Safety issues
- Cyber security
- Quality issues
- Lack of skilled labor

Opportunities

- Sustainable construction processes
- New business markets
- Collaboration among industry stakeholders
- Digital transformation
- New materials/ construction techniques
- Encouraging career opportunities for young graduates
- International investment
- ESG funding
- Public Private Partnership
- Modular construction

Threats

- Continued coronavirus restrictions
- Supply chain disruptions
- New pandemic variants
- Delay of adopting new technology and missed innovation opportunities
- Communication
- Precedence of contract awards to lowest price
- Misuse of value engineering with a risk to quality
- Inflation /escalation

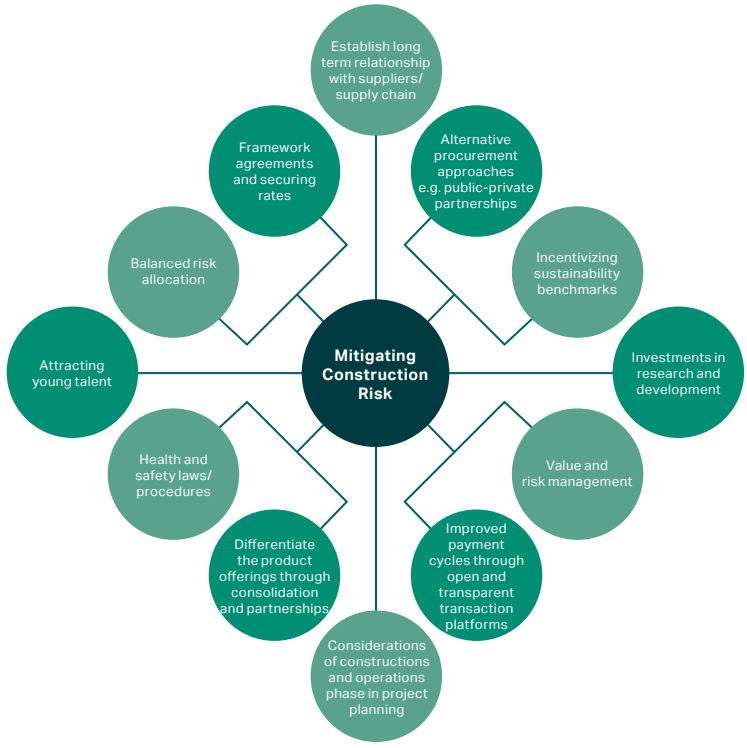
MENA construction risk mitigation

In terms of weaknesses and threats, significant challenges remain to the construction market and its successful delivery and recovery.

One of the key challenges to be faced in 2022, is the pandemic induced escalation of commodity prices. Notably, since the start of 2021, average prices for steel (structures and reinforcements), aluminium, copper and chemicals have risen over 25 per cent in the region.

According to a MEED report "As the construction industry grapples with higher costs, clear communication and consensual project adjustments are key to addressing stakeholder interests".

Some of the key topics leading into 2022, in terms of recovery and mitigating risk in the MENA region, are:



At the time of writing this handbook, another factor that has the potential to impact the industry is the news that the UAE public sector is transitioning to a new working week. Currently the same as the rest of the region with a Sunday-Thursday working week, the UAE will move to a Monday-Friday working week (with a half day on Friday) from 1 January 2022.

This shift is reported to support economically improved payment cycles through open and transparent transaction platforms. This is set to incentivize sustainability benchmarks' value and risk management investments through research and development recovery. In addition, it will align the country with international markets and in response to improving the social, family and overall wellbeing of the citizens and residents of the Emirates.

With many private companies set to make the same move, it remains to be seen how this will affect the whole private sector and its coordination with the GCC and wider region.

MENA awarded contracts

The country with the highest value of awarded projects in 2021 was Qatar, with an approximate total of USD 20 billion (tracked to Q3 end). This equates to a 38 per cent market share (recorded by MEED Business Intelligence). This was followed by Saudi Arabia with USD 13.5 billion - a 24 per cent market share. In third place was the United Arab Emirates with USD 6.7 billion, equating to a 12 per cent market share.

The busiest sector for awarded projects was gas which saw a 37 per cent share, followed by construction infrastructure at 22 per cent. Lastly, power projects came in third with 10 per cent.

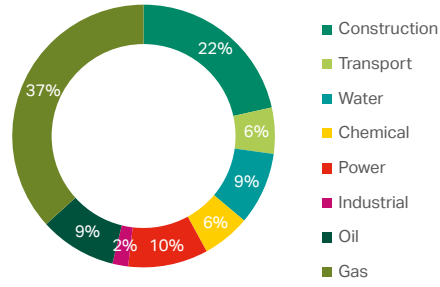
Of Qatar's awarded projects, circa USD 15 billion was recorded in liquefied natural gas (LNG) projects for the North Field East Project (NFE) which is regarded globally as the largest LNG project. Comprising the construction of four mega LNG trains, each with a capacity of 8 MMTPA, the project also included associated facilities for gas treatment, natural gas liquids recovery, as well as helium extraction and refining within Ras Laffan Industrial City.

Saudi Arabia saw USD 3.8 billion of investment in power projects with USD 1.6 billion recorded in Solar PV renewable energy projects, including a 1,500Mw powerplant for ACWA and two powerplants for REPDO (Renewable Energy Project Development Office) 600Mw in Alfaisalia and 300Mw in Jeddah. For building projects, Saudi Arabia saw USD 2.7 billion worth of projects awarded consisting several housing projects and early stage infrastructure work for the PIF giga project developers.

The UAE saw USD 2.7 billion awarded in building and infrastructure works in Q3 2021. This mainly consisted of residential housing projects with key developers awarding the following values; Emaar USD 0.37 billion, Majid Al Futtaim USD 0.35 billion and Union Properties USD 0.28 billion.

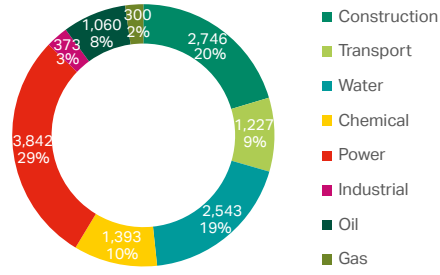
Although Egypt recorded a lower overall value in comparison of awarded contracts up to Q3 2021, it remains a strong market in terms of the building and infrastructure sector as they recorded USD 3.2 billion worth of project awards. The most notable award was Egypt's Ministry of Housing Utilities & Urban Communities Downtown Towers project - a USD 1.9 billion high-rise project comprising five residential towers overlooking an artificial lake in New Al Alamein City. This signifies the beginning of a strategically important city planned by the Egyptian government for 2030.

Gulf project awards % 2021



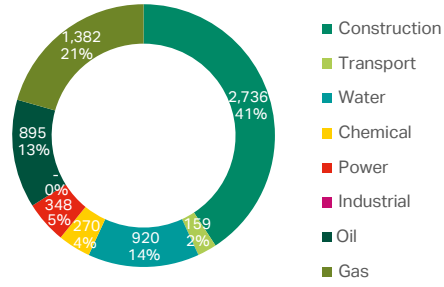
Source: MEED 2021 Q1-Q3

KSA project awards % 2021



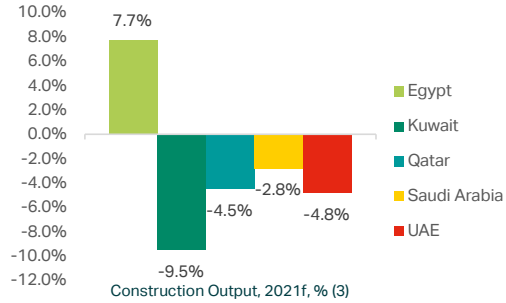
Source: MEED 2021 Q1-Q3

UAE project awards % 2021



Source: MEED 2021 Q1-Q3

Construction market growth rate %



Source: Global Data/BMI Research

MENA construction considerations

The growth of the construction market will continue to depend on MENA governments implementing stimulus packages for 2022 and beyond.

The pandemic induced set back in construction activity has provided focus and opportunities as businesses are now realigning to drive new efficiencies and help rebuild broken supply chains and seek more collaborative approaches.

An important lesson learned from 2021 cautions that contractual parties need to diligently review and understand the relief provisions within construction contracts. In MENA (particularly the Middle East) it is common to see standard contract terms and conditions adapted and amended; this will be an important consideration with certain provisions, like Force Majeure (which typically does not explicitly list pandemics and epidemics), to be amended to ensure a balance of risk between the parties.

There are revised mindsets across construction markets, as clients and construction organizations battle with market price volatility and delays to project execution and delivery, specifically over the last two years. This is encouraging certain developers and contractors to renegotiate existing prices (as contracts allow) and focus on commercial considerations during contract renegotiation. Overall, there is a focus to improve transparency, encourage healthier agreements between client and contractors, and enhance the procurement stance of projects in the region. However, the RICS emphasizes that during negotiations certain considerations should be made, such as reviewing project value drivers, assessing capacity within the construction market and allocating risk. The allocation of risk and overall security should be key considerations during the review and decision-making process.

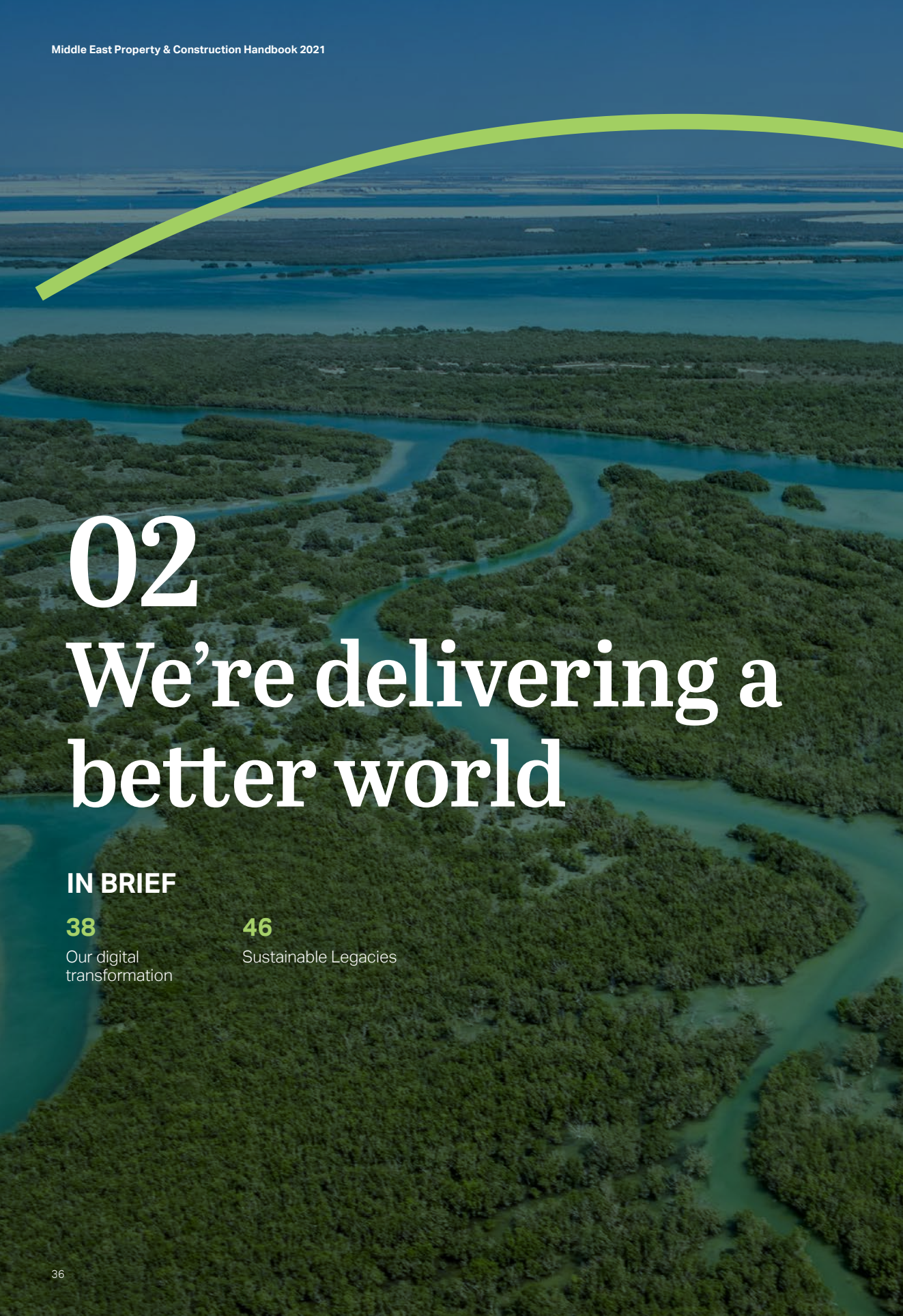
Key considerations:

Project value drivers: Reconsider the project from the perspective of the outcomes. Have these changed? What drives the project value?

Commercial capacity in the market: Is there unaccounted-for slack in the market pricing environment?

Use of investment: Is the level of bonding necessary? Can an improvement in cash flow provide required advantages?

Allocation of risk: Is the risk model out of balance with regards to reward?



02
We're delivering a better world

IN BRIEF

digital AECOM plan·spend plan·engage

Our digital transformation

Digital AECOM

Digital AECOM brings together the potential of AECOM's digital technologies to deliver a better world.

Working across the program and project lifecycle, Digital AECOM combines our leading industry knowledge with digital consulting services and products to define, develop, and implement personalized – and even disruptive – solutions that accelerate our clients' digital journey and achieve better outcomes. We exist within AECOM's sphere of innovation, and expanding ecosystem of tools, systems and processes – with a team of over 2,000 digital practitioners who understand both the urgency of the challenges facing the infrastructure industry, and our responsibility to respond in an impactful and enduring way.

As one of our core values, innovation drives our embrace and development of digital technologies.

From our digital asset management tool **PlanSpend** and our planning engagement platform **PlanEngage**, to our Virtual Consultation Room and digital twin platforms for critical infrastructure, we have developed user-friendly interfaces and approaches that provide greater connectivity between data, projects, and communities.

We constantly invest in our digital capabilities to deliver faster, smarter, and better. Working with agile specialists as well as some of the world's largest software providers, our extensive technology alliances allow us to select the right options to meet our clients' needs.

Budgets and timescales involved in infrastructure projects mean few can afford to gamble when it comes to digital adoption. Achieving net-zero carbon targets and circular economy ambitions add further impetus and complexity.

As digital experts and trusted advisers to the architecture, engineering, and construction industries, Digital AECOM is the bridge between the digital and infrastructure worlds, equipped to create a more sustainable and equitable future, and to deliver a better world.

To learn more about Digital AECOM please visit **digital.aecom.com** and **Digital AECOM: Why innovation + digital?**

or explore our numerous digital related articles at **digital.aecom.com/project_insight**

Spotlight on solutions

Our digital solutions of the moment to solve today's pressing challenges.

Digital Twin - There's never been a better time for asset owners to adopt digital twins to unlock significant value and provide benefits for themselves, their customers and safeguard their staff.

Digital Cities - As the data available to be captured from our cities continues to expand, and digital technologies become more diverse, the potential to apply them to revolutionize how we design, plan, deliver and run cities going forward is transformative.

Virtual Consultation - An interactive digital solution created to consult with groups of people outside of the 'traditional' consultation event setting.

Transforming project delivery

Our clients count on us to think without limits. By harnessing the power of digital technology and innovation, and connecting our technical experts and visionaries around the world, we deliver tailored solutions and transformative outcomes for our clients and the communities they serve.

Using a bespoke AECOM-developed Reality Capture tool, comprising a mobile phone, 360-degree camera and Cloud application, we're able to take 360-degree images of projects that are automatically uploaded and stored on a secure cloud server quickly and easily, visually documenting construction-site progress throughout a project's lifecycle.

The tool allows us to document site progress faster, with stakeholders able to view and assess the information at any time and from anywhere. The images can be easily retrieved as the application logs their location and capture times which is in stark contrast to traditional photograph repositories that either rely on extensive tagging or renaming.

The 360-degree images provide a more ubiquitous view of projects, which would traditionally involve taking dozens of photographs at multiple locations.

- Project stakeholders to assess site progress remotely anytime and from anywhere by taking a virtual walk through.
- Dedicated micro-site for stakeholder access to an immersive virtual site walk-through.
- Visually documenting construction site progress through the use of 360 degree images.
- Promoting transparency across projects and enhancing trust.
- Quicker documentation of site progress.
- All information is stored on one platform, in one place.
- Health and safety concerns can be picked up and shared with the SH&E team.
- Efficient claims handling due to the ability to view an archive of project images tagged with the same GIS data.

Global Unite

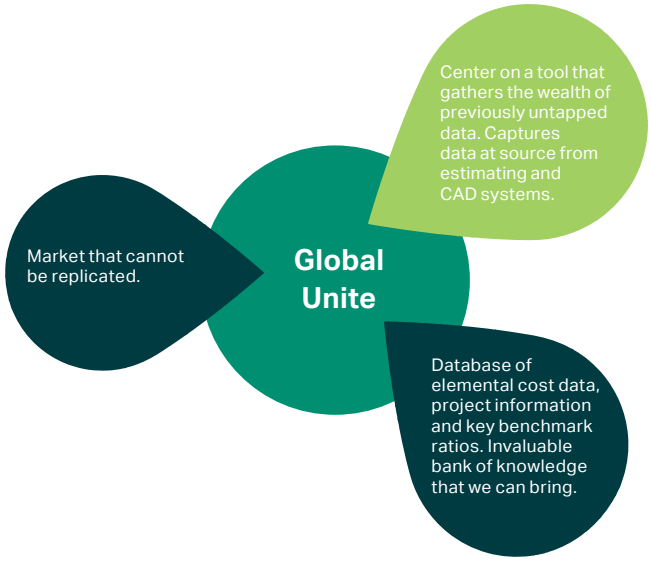
AECOM's Global Unite is a data warehouse for our international data capture, benchmarking and project performance indicators. This data, which we have gathered from our involvement in thousands of projects, helps us to efficiently benchmark project costs and establish project cost plans.

In this era of data, we are facing a growing number of requests that require rapid solutions based on evidence and data. Instead of relying on locally stored and constrained sources of cost and benchmarking data, our cost managers can now access a vast and growing pool of data generated from real projects.

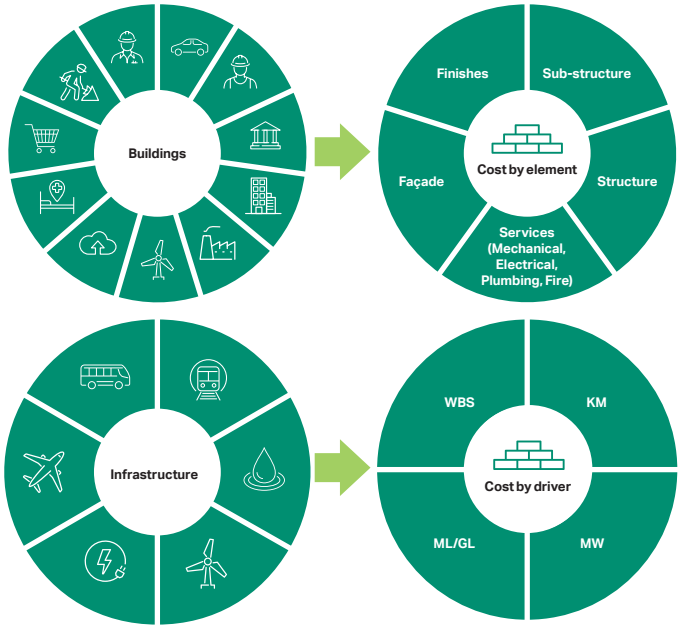
Using GUIDE – our mobile version of Global Unite – we can now instantly analyze parameters that define how effective or efficient a building is (or is not) against local or global standards for all buildings types, and produce indicative cost estimates in the early phases of a project.

Global Unite can help our approach to deliver projects in the following ways:

- It gives our clients unparalleled access to quality global and local knowledge that adds value to their project;
- Through direct comparison of our clients' project with global data, we can show clients what best practice is and how their project compares;
- It gives us the ability to collect and share project performance data from across the whole of AECOM;
- It centrally gathers the wealth of untapped data that we generate as we do our daily quantity surveying/ cost consultancy work within our individual geographies;
- It takes knowledge from our cost planning and measurement systems, and applies data mapping rules to manage differences in geographic definitions; and
- It captures data at its source and allows us to deliver local and global knowledge in a consistent way.



What information can Global Unite hold?



The system works by drawing on our personal experiences and the benchmarking data to generate an initial view of the likely project cost and update the cost plan moving through the design stages. Building on the available design information, while leaving room for potential site or project specific elements, Global Unite produces a cost plan that accurately reflects project requirements.

Our key global clients see the value of the tool too. We recently used GUIDE to complete a benchmarking study for a global healthcare provider. Using data from over 500 healthcare/ healthcare allied schemes around the world, we identified high level costs per m^2 for a number of project typologies similar in scale and complexity to the schemes undertaken by the client. A major manufacturer is also now using GUIDE to manage their own project cost data around the world, in their own format, by using the benchmark reports and generating indicative costs from their historical and current data across any geography. Several USA State Education Departments are utilising GUIDE to forecast costs on proposed new projects similar in nature to others, and have converted their Excel benchmarking worksheets into Global Unite.

5D Building Information Modelling

Building Information Modelling (BIM) is used to describe the process of designing, constructing and managing a building (or other design asset) in collaboration with the entire team. BIM develops throughout the asset's lifecycle and represents a single source of truth by using the same system or model as compared to using separate packs of conventional drawings and information sets. BIM is used to plan, design, construct, operate and maintain diverse physical infrastructures.

Whether designing or constructing bridges and roads, office towers and apartment blocks, pipelines, factories or schools, an information model or a database can be created that contains information about what will be built, how it will be built and how it will perform. Enabled by technology, we can create a synchronised, collaborative, digital representation of assets to virtually construct and test a project before we do so in reality.

A BIM model usually includes the 3D shape of the objects, but it can also include their cost, installation date, or operating parameters.

We can attach practically infinite additional data to any object or category of objects in a BIM database, and then use that data to manage information flow across multiple lifecycle phases and between multiple parties.

By creating a single source of project information, and by making this available across the design, construction and operation teams, we can increase our accuracy and efficiency. We can also realise significant savings on the lifecycle cost of operating an asset.

The 5D BIM process

For the cost management team, our focus is on 5D BIM. This refers to the linking of cost information to a 3D model. The number "3, 4 or 5", in connection with BIM, relates to the type of information associated with the model. It refers to other dimensions, such as time (4D) or cost (5D). 2D and 3D essentially refer to CAD 2D plans and 3D models, while 5D BIM entails the intelligent linking of individual 3D CAD components to cost-related information.

Understanding the process

Moving over to the 5D BIM process is an enhancement to our current systems and implementation. The process aims to automate much of the measuring, estimating and bill production stages. The value lies in the fact that it will enable cost managers to be more proactive and to spend more time on cost engineering and management, as compared to measurement and cost reporting only.

In brief, shifting our focus towards the 5D BIM process requires the following:

- Cost manager contribution and buy-in to the development of the BIM execution plan.
- Involvement with the design team prior to the start of design work to communicate our cost extraction design requirements.
- The application of a cost database as a parameter to the objects contained in the 3D model.
- Base our measures primarily on 3D design information.
- Creating a unified link between the design information, our measures and our costs

The possible benefits of BIM from a cost management perspective are:

- Fast, reliable, and accurate quantity take-off and cost estimation.
- Auto computation of calculations, hence reduced calculation mistakes.
- Categorized cost reporting and estimation via the use of zones/locations.
- Improved visualization of the elements for measurement and costing purposes.
- Enhanced communication and collaboration amongst the professional and project team.

Our PCC team have developed a thorough leadership document that is an essential guide for quantity surveyors, cost managers and cost estimators looking to be involved within a project utilising BIM.

The document further acts as guidance notes to the design team about modelling best practices and requirements for the quantity surveyor to be able to rely on the object data within the 3D model. The document makes recommendations based upon 5D-friendly modelling practice to standardise the output of 3D models in a format that is 5D compatible.

By applying the guidance within the document, the need for manual take-off will be greatly reduced. The ultimate goal is that the development of consistent modelling best practice improves the quality and usability of model data.

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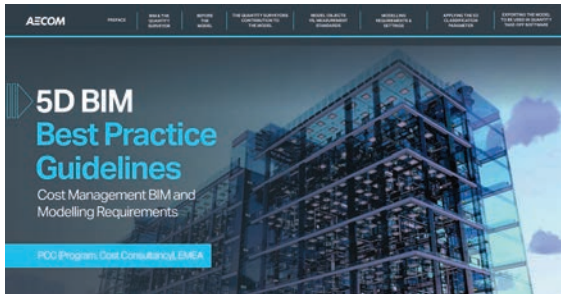
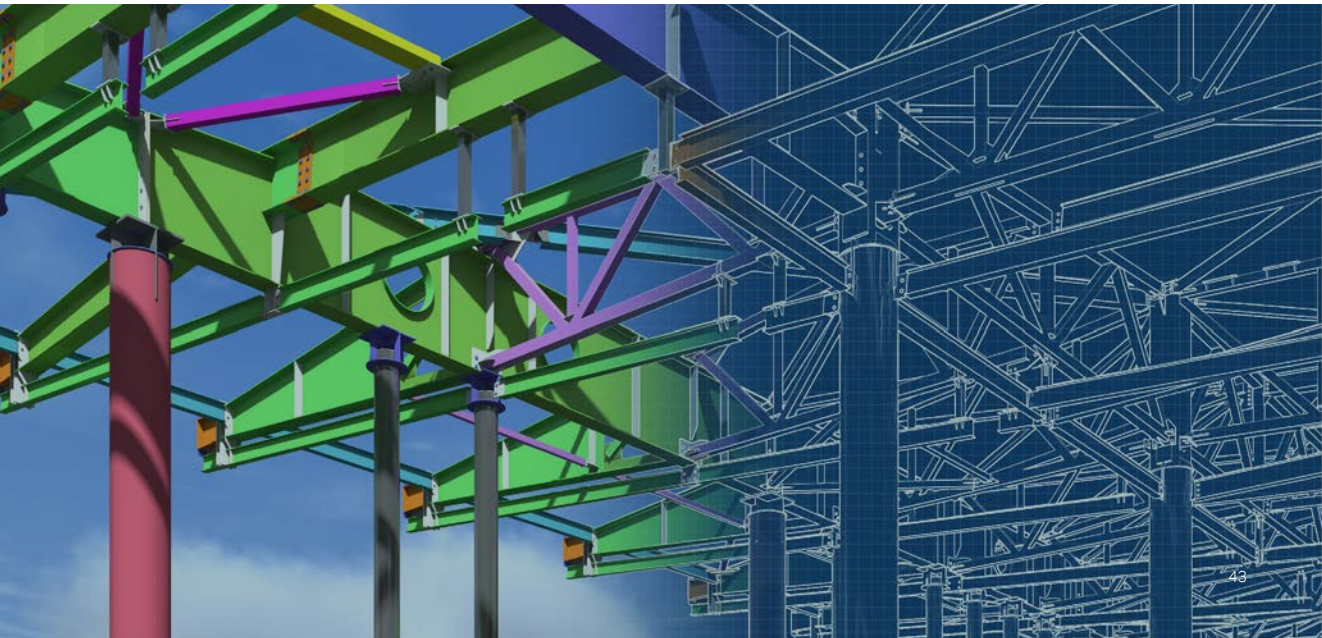




Digital Project Delivery (DPD) and research support

AECOM promotes a collaborative working environment underpinned by digital technologies. Our focus is on implementing more efficient methods to design, procure, construct, operate and maintain built assets and infrastructure.

Our cost managers and consultants are fully aligned to standard DPD protocols and procedures. This ensures consistency and successful outcomes in our daily working practices. Our teams are committed to the development of 5D BIM through a collaborative workflow that aims to improve BIM data quality and facilitate improved digital outcomes.

These include the ongoing development of the following:

- BIM execution plan
- Design/measurement coordination
- Risk/change management
- E-tendering
- Global collaborative tools
- Construction progress reporting
- 5D BIM
- Mobile connectivity to monitor site progress
- Paperless communications

Research is a key part of AECOM's aspirations to embrace complex challenges and deliver innovative outcomes.

Through our research and knowledge creation activities, we aim to stimulate beneficial cultural and business changes, resolve industry-specific problems, support our knowledge database and

deliver cost-effective, high-quality and relevant services.

We also undertake contract research on assignment for clients.

Globally, we have a tradition of supporting research collaborations, and we are currently pursuing a wide range of research studies with academic and research institutions, professional bodies and governments.

Current research nationally and internationally centers around:

- Local, regional and international influences on construction costs and prices.
- BIM cost models.
- Sustainability and green buildings - drivers of green design, construction, and operations within different building types.
- Improving infrastructure project delivery in the Middle East.
- Tall, large and complex buildings - efficiencies in construction and lifecycle costing.
- The triple bottom line in construction and property development.
- The soft landings process for buildings.

We have ongoing collaborations across our international offices with specific regards to global infrastructure sentiment surveys, sector-specific research and developing global project-cost databases.

Finally, we aim to work closely with the industry on continuing educational workshops and in developing relevant industry reports and publications.

Kingdom Center, KSA

Sustainable Legacies

Sustainability is at the core of what we do and how we operate.

The need for change

In ways that are both devastating and transformational, the coronavirus pandemic has highlighted weaknesses and inequities in the systems that support quality of life and prosperity in our already fragile world. It has led us and our clients to rethink what's next, reorder priorities and accelerate changes that not only help repair what's broken, but lead to improved, lasting outcomes.

As the world's premier infrastructure consultancy and a leader in environmental, social and corporate governance (ESG), we are determined and well positioned to deliver positive, impactful and sustainable legacies for our company, our communities and our planet.

With ESG principles embedded into everything we do, the goal of our Sustainable Legacies strategy is straightforward: to ensure that the work we do in partnership with our clients leaves a positive, lasting impact for communities and our planet.

The strategy has four themes, each of which are detailed below:

Embed sustainable development and resilience across our work.

Improve social outcomes.

Achieve net-zero carbon emissions.

Enhance governance.

How are we creating sustainable legacies?

Delivering sustainable legacies is a multi-layered topic. At a micro level, the focus tends to be on sustainability here and now: energy strategies to reduce emissions, offsetting and other mitigation tactics, sustainable development, resiliency, and the creation of a waste-free circular economy. At a macro level sustainability takes a global approach to consumption over the long term in the interests of the planet and the whole of society.

In line with this and reflecting post-pandemic priorities, we have developed four themes of our sustainable legacies strategy: embedding sustainable development and resilience across our work, improving social outcomes (including equity, diversity and inclusion), achieving net-zero carbon emissions and enhancing governance.

#3

In Engineering News Record's 2021 top environmental firms

Scopex™

ScopeX™ focuses on reducing carbon emissions associated with our clients' projects through our engineering designs. By understanding and quantifying the carbon implicit in these designs, we can identify the optimum combination of location, situation, site, logistics, materials, construction methods and in-use operations to minimize energy use, optimize sources of renewable power and integrate nature-based solutions wherever feasible. ScopeX™ achieves this through a process that starts with diagnostic questions. It incorporates a set of tools to resolve the challenges revealed by these questions, and a carbon aggregator to report our total impact with clients over time.

We anticipate that the following six decision points will have the most impact, and as such they form key steps in the ScopeX™ process:

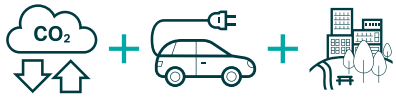
1. Linking cost and carbon in early design optioneering

By quantifying carbon and cost together, comparing options and selecting low carbon options from day one, we support clients to achieve the best balance between cost and carbon load.

2. The carbon and business case for choosing refurbishment over new build

Where feasible, refurbishment should be proposed as an alternative over new build if it reduces the carbon footprint while meeting the client's brief. Using ScopeX, the carbon and business case will be immediately visible.

3. Re-using existing materials



As part of the process, materials that may already be on site, including equipment, foundations, construction materials and considering green or nature-based infrastructure, will be considered, along with their carbon and monetary impact.

4. Low carbon materials and technologies

These will be considered, along with local availability and sourcing local where possible.

5. Future-flexibility

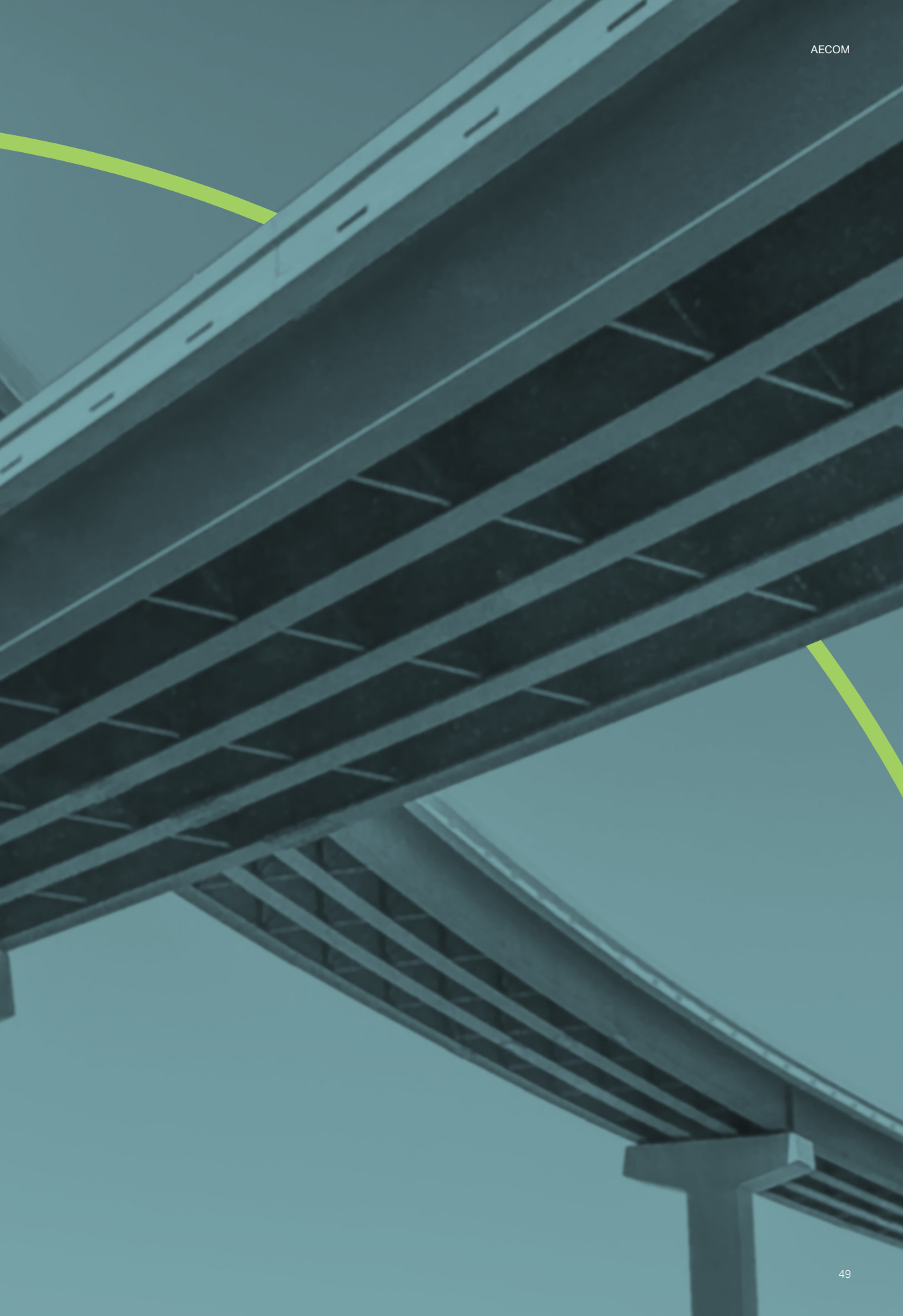
To reduce expensive retrofitting, designs that consider the next life of the asset will be detailed, with approaches that lend to modular fabrication and disassembly.

6. Low carbon materials and technologies

Design and build-out will be optimized to reduce redundancy and waste generation.

03 Articles

IN BRIEF



Vertical farming: How can vacant buildings support the UAE's food security goals?

The ever-evolving skyline of the United Arab Emirates (UAE) continues to captivate its citizens, residents and tourists alike. It is home to some of the world's most iconic structural masterpieces satisfying an array of architectural tastes. Over the past 50 years, we have watched projects such as the Burj Khalifa, Dubai Airport, Louvre Abu Dhabi, Palm Jumeirah, Port Rashid and Sheikh Zayed Road — to name a but a few, shape the Emirates' infrastructure, transport services and skyline since its first National Day in 1971.

The UAE does not miss an opportunity when it comes to innovative design and bold ideas. Building bigger and better is a common theme across the nation. The country is famed for its construction industry and is certainly not a beginner in the game. The UAE is home to over 1,000 hotels (Statista) and a multitude of commercial office buildings. In recent years, the country has moved into the cultural sector with the construction of the Louvre Abu Dhabi and Museum of the Future, Dubai.

So, what next for the UAE? We, at AECOM, are keen to explore the rising trend and opportunities for inner-city agriculture and food manufacturing within the UAE. We're specifically interested in how indoor farming can meet consumer demand for fresh produce and in turn reduce reliance on imports. The idea stems from:

- The number of buildings that have stalled during construction and transforming them through innovative AgriTech solutions.

- Supply-chain disruptions and increasing costs of imported food produce, which were exacerbated by coronavirus.

Current statistics for the exact number of incomplete construction (buildings) projects are not known. However, when passing through the Emirates' cities and communities, their concrete shells are visible, nestled amongst occupied commercial and residential structures, and perhaps ripe for a revived purpose. In Dubai, a new law passed in 2020 governing unfinished and cancelled projects. The tribunal will review and settle disputes and complaints that have arisen on unfinished, cancelled or liquidated real estate projects. Combined with the cultural shift in the AgriTech industry the tribunal outcomes may perhaps encourage the re-purposing of such buildings.

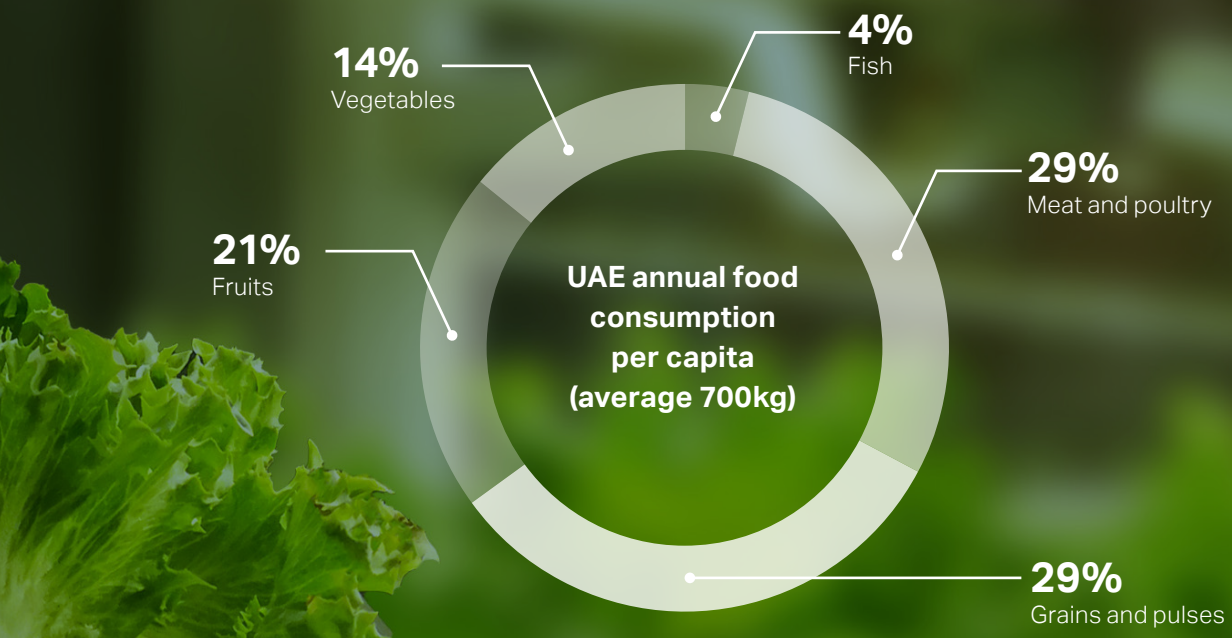
Statistics by Trowers & Hamlins report that the UAE imports an estimated 80-90 per cent (as of 2019) of total food supplies. In 2019, the UAE ranked 31st in the world as a food secure country by the Global Food Security Index (GFSI). The Food and Agriculture Organization of the United Nations (FAO) defines four pillars of food security; food availability, food access, utilization and stability, which the UAE achieves with its ability to purchase food from international sources and the upheld political and economic position.

The National Food Strategy aims to make the UAE the world's best in the Global Food Security Index by 2051 and among the top 10 in 2021.

In 2020, the UAE's Federal Cabinet approved a national system for sustainable agriculture with the aim of improving the efficiency of the UAE's farms, thereby enhancing food self-sufficiency. Creating new opportunities that support the sector remains highly ranked on the index. The UAE has made significant progress in terms of its commitments and targets for not only reducing carbon emissions and new climate change targets, but also through its commitment to becoming self-sufficient and supplying food from domestic sources.

The UAE media reported that in Q1 2020, 3.5 million tonnes of food was imported into the UAE, equating to more than AED 13 billion. The UAE also exported 918,000 tonnes, over AED 3.7 billion. According to the Emirates Council for Food Security the annual average consumption of food per capita is 700kg split as per the following food groups.

UAE annual food consumption per capita



7600m²

In 2018, it was reported that the UAE agreed on a deal for 12 new vertical farms allocating 7,600 square meters.

$100m

The Abu Dhabi Investment Office (ADIO) announced an initial investment towards indoor farming.

$272m

Value of first investment of a greater masterplan.

In 2020, the Abu Dhabi Investment Office (ADIO) announced an initial investment of USD 100 million towards indoor farming, the first investment of a greater masterplan valued at USD 272 million targeting AgriTech.

UAE success stories

Vertical farming is a pioneering contribution in the achievement of food supply targets, of which the produce is grown and distributed domestically.

In isolation, this method will not meet the UAE's climate change and carbon emissions commitments or mitigate food import, but it will play a significant part. In 2018, it was reported the UAE agreed on a deal for 12 new vertical farms allocating 7,600 square meters of land to the enterprise. Later, in 2020, the Abu Dhabi Investment Office (ADIO) announced an initial investment of USD 100 million towards indoor farming, the first investment of a greater masterplan valued at $272 million targeting AgriTech. The funds will be used for research and development to support the UAE to become more resilient and the first country in the world to commercially grow tomatoes under artificial light.

Al Badia vertical farm was the first of its kind in the GCC and located near the built-up centre of Downtown Dubai. Their sentiment is to "close the gap between farm and chef's kitchen". They are currently serving local restaurants with 'home grown' micro-greens and herbs.

Another success story is a hypermarket in Yas Mall, Abu Dhabi, growing microgreens in store. They are currently seeking a lightbulb supplier to provide a bulb with reduced power to offset the electricity running cost.

Emirates Flight Catering and Crop One built an indoor vertical farm in 2018 to spearhead greater agricultural self-sufficiency. This was an innovative solution to improving Emirates Group productivity, product and service quality through securing their own supply chain of locally sourced vegetables and reducing their environmental footprint.

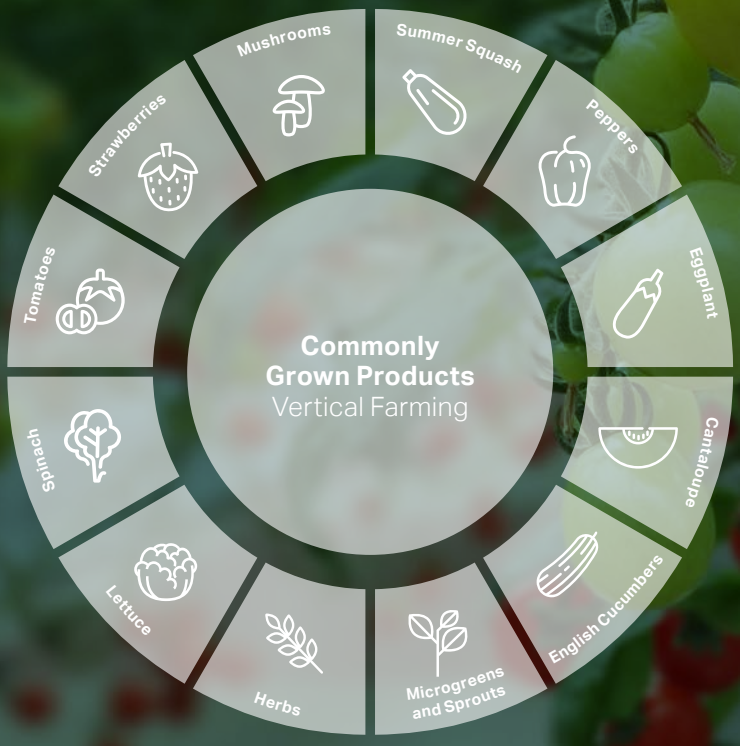
With encouraging examples along with other in-country food and beverage outlets sourcing produce straight from the 'local farm', the UAE has the foundations in place to reduce the carbon footprint directly associated to food imports whilst meeting its food supply self-sufficiency objective.

Cost drivers

In 1999, microbiologist, Dickson Despommier, established the terminology 'vertical farming' and introduced the idea as a solution to farming in countries with climate restrictions like the UAE, where fruit and vegetables are difficult to grow via traditional farming methods. The process can support the reduction of water usage; vertical farming reportedly uses 95 per cent less water than conventional farming.

The technology and conditions required to create an environment in which fruit and vegetables can thrive provides limitations. In most cases, vertical farms focus on herbs and salads as they require less energy and water in comparison to other fruits and vegetables. This does not mean that fruits and vegetables cannot be grown indoors, but they will be more costly as they require more intensive energy and water maintenance.

In instances where water sources are scarce or protected, the operational water systems configured within the indoor farms require consideration. Water is a precious resource and even though indoor farming requires its use in the operational aspect, as well as through crop growth, its dependence should not be forgotten. An ideal scenario for indoor farming is that the crops are both biologically viable (can be grown) and economically viable (can make money), taking into consideration the optimum climate, demand and most appropriate technique.

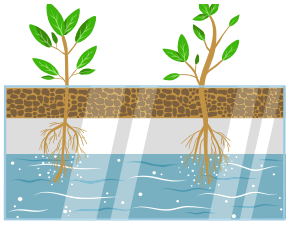


Indoor farming

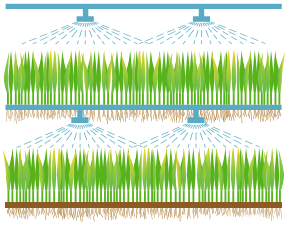
Vertical farming: an alternative method to conventional farming which requires 95 per cent less water to grow crops such as microgreens, salads and certain fruits and vegetables.

The produce is grown through processes such as Hydroponics, Aeroponics and Aquaponics. The vertical farming systems, according to Despommier include skyscrapers, integrated with renewable energy technology such as solar panels, wind turbines and hydroelectric power. Mixed-use skyscrapers incorporate the vertical mechanism in a closed environment, but also grows crops utilizing natural sunlight from top floors of commercial office space where optimum sunlight is sourced.

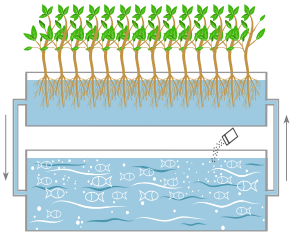
Stackable shipping containers can grow crops such as strawberries and leafy greens using hydroponics, LED lighting and heating and ventilation systems for optimal climate and temperature.



Hydroponics is a process using nutrient solutions and growing mediums rather than fertilisers and soil. The nutrients solution is flooded into the tray at observed intervals, excess water is recycled back to the reservoir ready for the next flood. Artificial intelligence (AI) comes into play and can monitor the growing habits of each crop to improve the process.



Aeroponics is a system whereby plants are grown with roots suspended in the air in a water misting environment without soil or water flooded into trays. The roots are continually sprayed with a misting nutrient solution. This method not only uses less water compared conventional farming but also in comparison to the hydroponic system.



Aquaponics is a method combining hydroponics with fish (known as aquaculture). The fish waste is used instead of a nutrient solution as mentioned in the previous examples. The water from the fish tank (or housing) is circulated to the grow trays, like the method used in hydroponics. Eventually this water, once combined with the bacteria within the plant trays, is converted into a vermicompost then used as a fertilizer for the crops, the water is then recycled back to the fish tank.

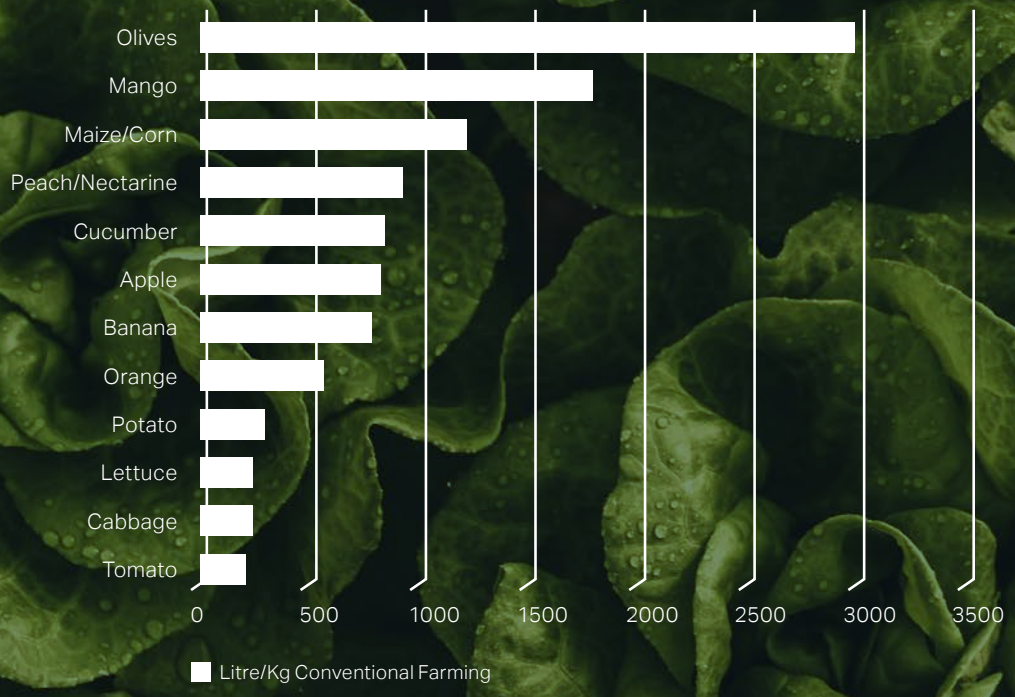
Adapting vertical structures and even 'skyscrapers' to create an indoor farm where produce is grown in vertical stacks on multiple levels, demands a greater built-up area compared to building footprint.

Farms require a 24/7 light source, temperature-controlled environment, water filtration system, irrigation, nutrients and artificial intelligence. Crops can grow all year round serving the local community and for export purposes. This solution is resistant to climate changes, arid land limitations and is adaptable to changing dietary habits.

The technology focus is based on maintaining indoor temperatures to an optimum 22ºC, which for the UAE will be met through chillers or district cooling. The crops require a continual 'light' that is artificially sourced from LED lighting and can be achieved through connections to power sources or through a photovoltaic (PV) system constructed on the building's roof. The irrigation (water) supply is filtered potable watered purified through a water osmosis system.

Further, the application of AI to indoor farming is limitless. For example, AI can monitor crop growth, detect issues with the crop's health, and signal actions required to optimise the next growing cycle. AI efficiencies can always be succeeded whether this be the control and measure of irrigation schedules (thus reducing water usage and waste even further than conventional methods) or gathering growing records for individual crops by understanding the required technique for improved harvests.

Litre of water/kg food produce from conventional farming – Waterfootprint.org



*Please note that this data is based on a global average, water usage varies from country to country.

> The Emirates News Agency reported in 2019 that Dubai alone is home to approximately 11,800 restaurant and café outlets, which have the potential to source their food supplies from local vertical farms."

Final message

The Water Network predicts that by 2030 global water demand will outweigh supply by 40 per cent. The effects of climate change have already impacted the water cycle leading to droughts and extreme rainfall, both of which are detrimental to the agricultural industry.

Vertical farming is part of the global solution that also targets the reduction of greenhouse gases which agriculture and forestry account for 25 per cent of what the world currently produces. Furthermore, for the UAE it creates opportunities that give purpose to partially-built structures and provides a mechanism for improving food self-sufficiency and a reduced carbon footprint.

The Emirates News Agency reported in 2019 that Dubai alone is home to approximately 11,800 restaurant and café outlets, which have the potential to source their food supplies from local vertical farms. Future investment and advances in the AgriTech industry through the application of hydroponic, aquaponic, aeroponic vertical farming will enable produce to be grown 'more efficiently' and will go some way in reducing water demand and the environmental impact of the current levels of food imports.

The UAE has observed incredible development as a country over the last 50 years and the drive for an innovative change in transforming the current food chain is visible. Investment in both the public and private sectors and utilisation of sea and air connectivity will support the country to achieve its AgriTech and food security goals.

This article is written using research of data and information undertaken by the author from various web-based sources. The purpose of this article is not to provide design solutions for 'vertical farming' methods but provide an insight and analysis into the topic using available information from current examples. The exact technology operating in existing indoor farms is highly confidential and an explanatory overview is provided for information.

Embodied carbon and the industry's role in reducing global emissions

This article explores the nature of embodied carbon, where it is found in the built environment and how it can be measured, documented and reduced with reference to current initiatives, tools and examples in the construction industry.

The chances are that you are reading this article on an electronic device rather than in printed form, such as a magazine or journal. But which medium produces the least carbon emissions? Straight away you can differentiate the two by the fact that an electronic device requires a power source, such as a battery charged by electricity to operate. The magazine or journal though does not, so you may reasonably conclude that the printed matter has less carbon emissions. However, it is not as simple as that when you consider the embodied carbon.

A study by Alma in Finland determined that it takes between 150-190kg of CO_2e (carbon dioxide equivalent, the common scale for measuring the climate effects of different gases) to produce a newspaper or magazine. Apple, the producer of iPads on which millions of publications are read every day, claim that the total lifecycle emissions of a typical model are 130kg CO_2e of which only 30 per cent are associated with customer use (iPad Environmental Report, Apple). Clearly there are many factors at play that could influence these findings, such as where the energy is sourced for production and use of sustainable materials. Although these figures cannot be taken as absolutes, they do provoke holistic thinking to carbon emissions and suggest that while the humble magazine or newspaper may have zero 'operational' emissions, its carbon footprint can be higher than an electronic device.

Turning this thinking to the construction industry and the built environment, we see the clear importance this sector has in reducing global emissions.

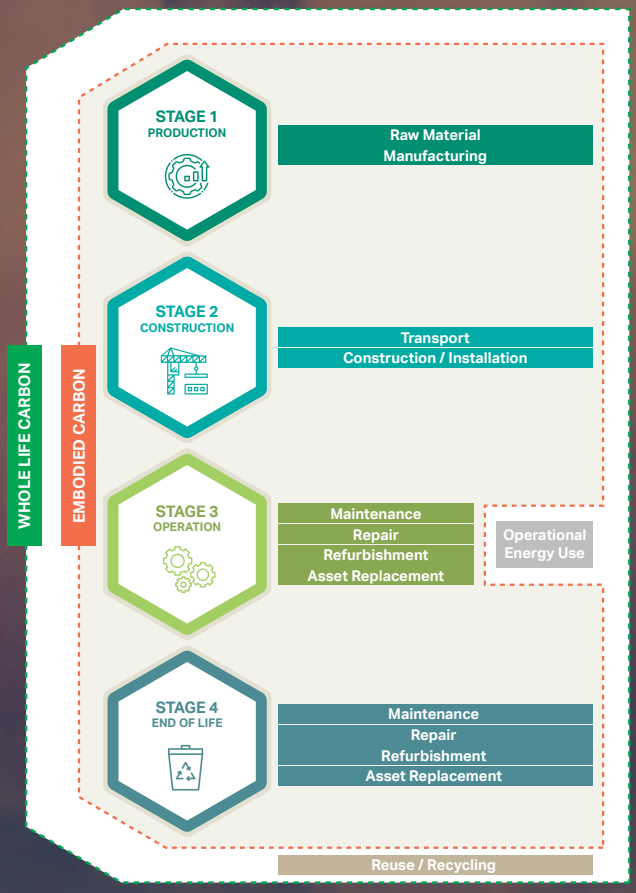
According to the World Green Building Council and the UN Environment Global Status Report, of all emissions produced from all human activity worldwide (including printing newspapers and manufacturing iPads), buildings are currently responsible for 39 per cent: 28 per cent from operational emissions from energy required to heat, cool and power them, and 11 per cent from materials, construction and maintenance activity. These figures aren't likely to decline either. As the world's population continues to grow, the International Energy Agency projects that the total global building stock will double in size by 2050.

Numerous plans for action have been announced by governments and organisations worldwide on how they will achieve net-zero carbon emissions over the coming decades, with an obvious focus on reducing operational emissions. However, if these targets are going to be met, the embodied carbon responsible for 11 per cent of global emissions from the construction industry alone must be understood, measured, and minimised where possible.

Embodied carbon in the built environment

In the context of the built environment, embodied carbon accounts for approximately 58 per cent of all emissions of a building, with the remaining 42 per cent associated with operational energy use. The lifecycle carbon impact of a building can be split into four stages: production, construction, operation and end-of-life. The production stage accounts for approximately 33 per cent of a building's carbon impact and includes the extraction of raw materials, transportation and manufacturing into building materials and products. The construction stage accounts for a further eight per cent of a building's carbon impact and includes all construction activity, including transport of materials and labour to site, installation and commissioning. This means that before a building is ready for occupation it has already incurred approximately 41 per cent of the total carbon impact 'up front'. During occupation, we enter the operation stage where all direct emissions from energy consumption are incurred, accounting for up to 42 per cent of lifecycle carbon impact, with embodied carbon seen in maintenance, repair, refurbishment and asset replacement activity accounting for a further 11 per cent. The remaining six per cent of carbon impact is found in the end-of-life stage where demolition, waste processing and disposal activity is undertaken.

The greatest potential for a reduction in the carbon impact of a project is therefore found within the design stage. Research by C40 Cities, Arup and the University of Leeds suggest some key ways in which a reduction in embodied carbon can be achieved, and highlights the importance of switching to lower carbon materials and using materials more efficiently to reduce the upfront carbon incurred.



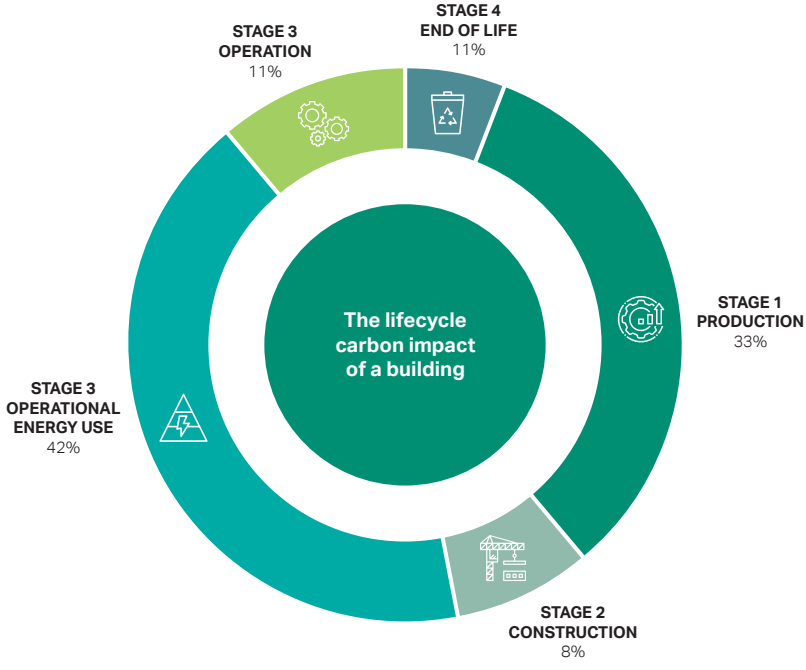
This can only be substantially achieved with an understanding of a material's embodied carbon, quantified by an embodied carbon assessment. More general practices during the design stage can be implemented, such as decreasing reliance on duplication in specifications and ensuring buildings are not over-specified either for intended loads or functionality.

An additional stage beyond the lifecycle of a building that includes recycling and reuse of materials can also be considered, but is not usually included in an embodied carbon assessment. However, as attempts to standardize measurement of embodied carbon continue, this is becoming a point of contention with some suppliers of materials and products that have high reuse or recycling potential that would offset otherwise high carbon impacts from production.

The challenges of measuring embodied carbon

Key to understanding the embodied carbon within a project is attributing the CO_2e to a product or material specified for it. This is usually expressed as a rate per unit of said product or material. There is currently a reliance on stated embodied carbon quantification from environmental information on the lifecycle of a product, for which a standardized Environmental Product Declaration (EPD) process has been outlined by the International Organisation for Standardization (ISO) in ISO 14025. However, there are several challenges with using EPDs, not least because they are constantly being updated as manufacturing processes and material selections change, resulting in complex and inconsistent databases. Further complications are found in the methodology for creating an EPD, which relies on the definition of the product using appropriate Product Category Rules (PCRs) that use Life Cycle Assessment (LCA) studies. LCA studies vary in terms of assumptions and considerations depending on the availability of data, and can therefore lead to inconsistencies in comparing products that fulfil the same function. Factors such as location, production methods, supply chain conditions and lack of third-party review create additional inconsistencies in EPDs that see various databases being used and no clear benchmark data available.

Progress is being made by private companies and non-government organisations to collate as much data as possible to ensure EPD databases evolve and become more robust. This is while attempting to standardize the way in which embodied carbon assessments are undertaken. The Royal Institution of Chartered Surveyors (RICS) has taken the lead in developing procedures for their members, recognizing their role in the industry and the impact surveyors can have in facilitating carbon reduction strategies. Publishing a mandatory practice statement for members, the Whole Life Carbon Assessment for the Built Environment, in 2017, they provided a methodology for calculating embodied carbon throughout the built asset's lifecycle and prescribed acceptable sources of carbon data. This followed their information paper published as early as 2012 in support of the whole life analysis of the construction lifecycle (Methodology to Calculate Embodied Carbon of Materials Information Paper IP 32/2012, first edition). Unfortunately, the carbon data is still reliant on the EPD system, and while a database of EPDs in the UK has been developed to produce the RICS Building Carbon Database in 2019, this is still evolving.



The development of embodied carbon measurement tools

Developing embodied carbon measurement tools, just like the databases on which they rely, is an ongoing process. There are already several tools available to measure embodied carbon, such as Carbon Designer, EcoCalculator and EC3. However, Carbon Designer and EcoCalculator are limited to early phase modelling, whilst EC3 places strong reliance on EPDs. Indeed, EC3 has been developed specifically to address the significant variances in EPD data by providing results as ranges, rather than absolute numbers, whilst at the same time acknowledging its limitations through lack of available data.

As part of their Sustainable Legacies initiative, AECOM have utilised the advances in carbon data and database development to produce their own embodied carbon assessment tool. Known as Scope X™, the tool has been developed with the intention of helping architects and engineers understand the carbon impact of their projects, allowing clients to identify where reductions in embodied emissions can be achieved. While targeted for projects in their design stage, it can also be applied to existing buildings considering refurbishment. In the Middle East, AECOM's Asset Advisory team are developing this tool further to work alongside their cost management teams, incorporating embodied carbon assessment into a wider lifecycle cost analysis using regionally specific data and location factors. It is intended that this tool will be adapted to all geographies in which AECOM operates, helping to deliver real reductions in CO_2e around the world, from multiple projects where AECOM are engaged as a consultant, project manager, designer or engineer. Elsewhere in the Middle East, Majid Al Futtaim Properties, a leading developer, owner and operator of built assets, have also developed their own in-house tool for embodied carbon measurement with reference to the methodologies published by the RICS.

Practical applications and demand for embodied carbon measurement

Practically, embodied carbon assessments are meeting an increasing market demand driven by corporate ESG policies, certification requirements (such as LEED), government strategies and, in limited instances, legislation.

There have been many publications on the issue, but awareness has only been raised relatively recently.

A significant paper entitled "Bringing Embodied Carbon Upfront" was published by the World Green Building Council in 2019, describing itself as a call to action.

Arguably the most accessible publication on embodied carbon to date, this paper has been referenced by multiple sources as governments develop and announce their net zero strategies one after another.

> "AECOM have utilised the advances in carbon data and database development by producing their own embodied carbon assessment tool, ScopeX™. The tool has been developed with the intention of helping architects and engineers understand the carbon impact of their projects, allowing clients to identify reductions in embodied emissions."

In the UK, where the RICS has undertaken most of their work to date in developing embodied carbon measurement methodologies, there has been pressure on the government to act to reduce embodied carbon through incentives and legislation. In particular, if they are to achieve a target of net-zero emissions by 2050. For instance, the 'Part Z Group' of architects, developers and contractors, including the Royal Institute of British Architects (RIBA) and the Institution of Structural Engineers (ISE), proposed that a new section (Part Z) is added to UK building regulations to compel projects over 1,000m^2 to report embodied carbon emissions.

The ISE have followed this with their own guide for members, "How to Calculate Embodied Carbon", in 2020 that highlights the need to calculate CO_2e in all projects and provided a structural carbon rating system (SCORS) to allow structural engineers to classify projects on a scale of A to G. Perhaps, understandably in the context of market and political pressures from their exit of the European Union and the coronavirus pandemic, the UK government has been reluctant to consider implementation of further complications in a major sector within a struggling economy. However, as a recovery is now underway, they have begun to consider how to address embodied carbon within a wider heat and building strategy, a move supported by the sector by the UK Green Building Council.

There is far more that can be done though. The UK government itself is the subject of an environmental campaign over the construction of a new Justice Quarter in the City of London, which aims to combine police and judicial headquarters on Fleet Street. Campaigners say the plan, that currently involves demolition, could be amended to refurbish the existing buildings instead, saving approximately 19,000 tonnes of CO_2e in the process. This highlights how refurbishment, rather than building new, can help to reduce carbon emissions. It also demonstrates how an understanding of embodied carbon could be used to reduce the carbon impact of a project, and how much influence governments could have to achieve the reduction.

In the UAE, the Emirates Green Building Council (EGBC) is taking the lead in establishing working groups and raising awareness of embodied carbon in the construction industry, but acknowledges there is a way to go. The EGBC Embodied Carbon Working Group has been formed to provide useful guidance to the industry with the aim that some legislation may follow to compel the sector to meet targets. While no specific legislation exists, the UAE National Climate Change Plan (2017-2050) and a recent declaration of UAE becoming a net-zero carbon country by 2050 – the first Middle East country to make such an announcement – provides a framework to which the issue of embodied carbon cannot be ignored if these targets are to be achieved. The plan itself, which does not explicitly mention embodied carbon, positions the Ministry of Climate Change and Environment as leader in raising awareness in partnership with stakeholders to take action.

Perhaps the most exciting opportunity to incentivize embodied carbon reduction is found within project financing, where performance against sustainability goals influence the interest rates available and access to loans. Widely referred to as 'Sustainability Linked Loans' and guided by principles such as those published by the Loan Market Association (Sustainability Linked Loan Principles,

"In the UAE, the Emirates Green Building Council (EGBC) is taking the lead in establishing working groups and raising awareness of embodied carbon in the construction industry, but acknowledges there is a way to go."

May 2021), these financial products reward borrowers for achieving pre-determined sustainability targets, which rely on the ability to measure, quantify and convey performance against them. This way of financing also meets the ESG demands of the lenders, who are under increasing scrutiny for lending to fossil fuel industries in particular. High profile examples of sustainability linked financing include the first such agreement between ING and Philips in Europe in 2017 and between Bank of America and General Mills in the United States in April 2021. While Europe is still at the forefront of this way of financing, the United States have seen a huge increase in demand in the last two years and lenders such as HSBC made Sustainability Linked Loans available for all their commercial clients in summer 2021.

In the Middle East, Aldar Properties announced in July 2021 that they have secured an AED 300 million Sustainability Linked Loan with HSBC linked to KPIs, becoming the first MENA company to do so.

Summary

Absolute values of embodied carbon measured are dependent on many factors that produce a level of uncertainty on a definitive value of CO_2e, in keeping with internationally accepted methodologies for conducting lifecycle analysis. The key to their effectiveness is consistency in approach. So long as the methodology and reference points for embodied carbon measurement stay consistent, embodied carbon assessments can be an effective tool for the measurement and reduction of carbon within the built environment as comparisons between materials are being made on a level playing field. The need to maintain EPD databases and their growing datasets from increased numbers of EPDs undertaken over time will provide more robust data points and more accurate assessments. Tools developed and used to provide embodied carbon assessments need to understand the multiple variables – such as geographic location of a project – to provide meaningful, relevant results.

An understanding of the challenges helps to produce effective tools for measuring CO_2e in projects and there are currently only a handful of companies and organisations that have the ability to do this. The effort and resources required to develop such capability mean that such abilities may be restricted to larger organizations in the short to medium term. Motivation to invest in the development of this capability may come from internal ESG policies, or external demand factors driven by legislation and market need to quantify CO_2e within projects.

Conversations around reducing our carbon impact are usually focused on emissions resulting from direct user activity. We all need to drive less, fly less, use less electricity, produce electricity from sustainable sources, recycle and reuse where possible. However, the traditional focus on operational carbon reduction and a misunderstanding of the true impact of embodied carbon remains and needs to be addressed. Direct emissions from any built asset can be roughly equivalent to the embodied carbon incurred 'up front' during manufacturing and the construction phase alone – and continue to be incurred throughout the asset's lifecycle from maintenance, repair, replacement and demolition. The need for the construction industry to understand, measure and reduce embodied carbon within projects to meet the demands of an informed client is therefore critical to the effort to reduce global carbon emissions if current targets are to be met. Raising awareness of the issue is just the first step.

Financing climate action

How embedding climate factors into decisions can help businesses adapt to a changing environment.

Accurate and benchmarked business risk reporting that properly accounts for climate change will be increasingly important as the drive to combat climate change broadens and accelerates. AECOM looks at the challenges of assessing climate risk and the opportunities for businesses who forge the way forward.

As the United Nations Climate Change Conference (COP26) convenes, the financial dimensions of this century's most fundamental issue are coming into focus. The need to incorporate climate risk into financial decision-making and commercial strategy, as well as disclosing on these in a complete and transparent manner, is emerging as a central challenge for businesses the world over. A new kind of thinking is called for: one that can accurately frame the financials of climate risk and provide robust evidence bases to investors, employers, customers and supply partners, as well as to governments and regulators. Financial impact and risk associated with climate change will be a fundamental part of the debate at COP26. Regardless of whether the Paris Agreement goal of limiting global average temperature rise to no more than 1.5°C above pre-industrial levels is met, climate change is here, and has the potential to disrupt every segment of the global economy. With the world already experiencing extreme impacts, climate risk has moved decisively from being an outlying concern to a crucial planning issue for business, with regard to both adaptation and the need to meet emission reduction commitments. Curbing carbon emissions and limiting global temperature rise will cost trillions in private finance, but the benefits will dramatically outweigh the initial costs.

1.5°C

Paris Agreement goal of limiting global average temperature rise to no more than this limit.

> Every financial decision needs to take climate into account."
>
> COP 26 Goal

With some effects of climate change already irreversible, adapting and building resilience is crucial. "Every financial decision needs to take climate into account," the COP26 goal emphasize.

In response, we are seeing fundamental shifts in financial markets, with increased investor attention and the emergence of investor-led climate change reporting standards and legislation aimed at protecting and improving the stability of the global economy. In line with this, there is also an urgent need for effective assessment and disclosure of climate-specific risks, enabling businesses to properly factor them into decision-making as well as disclosing their progress.

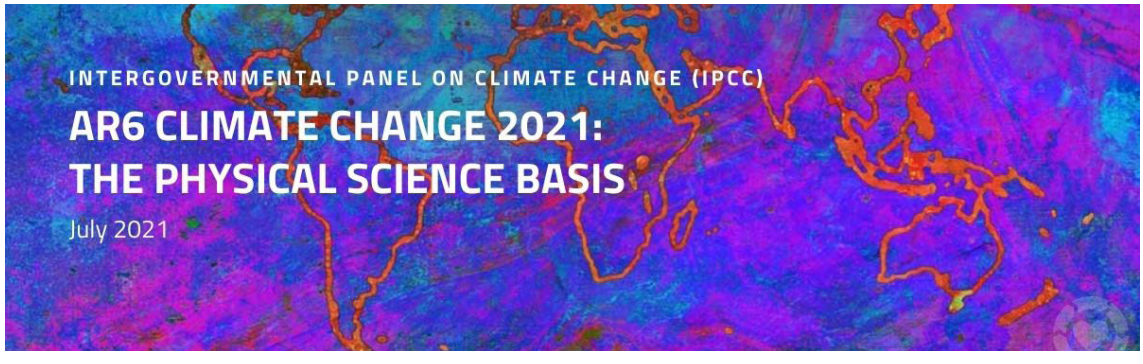
Integrating climate risks into traditional business risk approaches demands a new kind of analytics. Many of the risks are long-term, uncertain, changing and difficult to quantify compared with other components of commercial risk management. There is a need for companies and their auditors to become fluent in this emerging risk landscape. Some are aware of the new and potentially decisive risk dimension associated with climate change, but have yet to codify it in disclosures or in corporate strategies. However, responding to this challenge means businesses are able to plan, adapt, and transition towards a net zero economy, while providing investors and insurers with greater clarity and therefore confidence, in their long term viability.

The 2021 report by the Intergovernmental Panel on Climate Change (IPCC) has shown that inaction isn't an option. With global temperature rises on course to far outstrip the main Paris Agreement target, climate change is already affecting every region on earth, evident in the increased frequency and severity of extreme weather events. In the face of this unique challenge, failure to take steps to ensure resilience will likely present a future liability.

We at AECOM advocate a three-tiered approach: ensuring that the outcomes of climate risk assessment are reflected in strategic thinking across all aspects of an organization; identifying and embracing the competitive opportunities that, for many businesses, this change in strategy can offer; and achieving accurate and meaningful climate assessment, monitoring and disclosure.

72 %

Seventeen advanced economies found that overall 72 per cent of citizens were concerned that climate change would harm them personally.



A proactive investment stance

There is an opportunity to demonstrate proactive thinking and efforts to a world which increasingly values real climate action. The Pew Research Centre has been tracking attitudes to climate change since 2013, and the latest surveys indicate a huge growth worldwide in the view that climate change is a major threat. A study released in September spanning 17 advanced economies found that overall 72 per cent of citizens were concerned that climate change would harm them personally, with significant upward trends in almost all countries surveyed. This deep shift in public sentiment parallels the changes we have noted in investor priorities, and makes a powerful case for climate pro-activity as a competitive advantage.

There is no doubt that this decade is the one for accelerated climate response and action. The world's largest economies, including the U.S. and China, as well as the European Union, have set carbon reduction targets for 2030, targets that are increasingly being incorporated into the investment mandates of asset managers. Every demonstrable climate-positive action that companies take reduces the cost of capital and future financial risk.

Applying emerging standards to disclose climate risk

Demand from investors increasingly requires companies to account on reporting and forecasting climate-related risks that lie outside traditional risk analysis.

Of the available climate reporting guidelines and initiatives to enhance disclosure and mitigation of climate- related financial risk, the Task Force on Climate-Related Financial Disclosures (TCFD), created by the G20's Financial Stability Board in 2015, has risen to the fore as a go-to framework for financial climate risk, becoming part of the regulatory framework in several countries, including the EU.

The TCFD offers extensive guidance on recommended disclosures in the areas of governance, strategy, risk management, metrics and targets, as well as principles for effective disclosure and advice on assessing resilience across a range of scenarios. While businesses can use such guidelines to understand the kind of things they need to report, deciding what is material and how to accomplish meaningful climate risk disclosure remain big challenges for individual organizations. However, this is where the real value lies. Understandably, many organizations have not yet met these challenges.

With the support of AECOM, we have not only developed a road map and action plan for improved alignment to TCFD, but also engaged our organisation in finding new and innovative solutions to the climate-related challenges we face."

Rowan Adams, Executive Vice President of Corporate Affairs, Tate & Lyle

The TCFD says that corporate disclosure of climate-related financial impacts remains low, despite a policy statement from the International Accounting Standards Board that climate risks should be treated as material financial risks, and moves by some governments to legislate reporting requirements. Investor-led groups such as the Principles for Responsible Investment initiative have responded enthusiastically to the emergence of new climate impact financial reporting guidelines, but the corporate response has not always matched this interest. A recent statement signed by 567 investors representing USD 46 trillion in assets urged governments to implement mandatory reporting requirements in line with TCFD recommendations to ensure disclosures that are "consistent, comparable and decision-useful." In June this year, G7 finance ministers also called for greater coordination on mandatory disclosures, and there are signals that an international agreement may be forthcoming.

Our team at AECOM supported Tate & Lyle PLC, a global provider of ingredients and solutions for the food, beverage and industrial markets, to align its climate-related disclosures to the TCFD recommendations and to effectively disclose climate-related risks and opportunities through the company's annual reporting processes. We conducted a gap analysis of Tate & Lyle's corporate disclosures across the four TCFD thematic areas (governance, strategy, risk management and metrics and targets) to assess how well-aligned existing indicators were. Key stakeholders within Tate & Lyle, working in areas such as enterprise risk management, investor relations, sustainability programs and reporting, procurement, commercial and manufacturing, were interviewed to understand current processes and procedures across all aspects of the organization.

Part of the process was also undertaking a climate-change risk assessment for Tate & Lyle, considering the physical and transition risks and opportunities associated with its operations, as well as for key suppliers and markets. A review of climate-change projections and trends, relevant policy, legislation and industry progress informed the assessment.

Workshops were conducted with key personnel from a range of functions to build capacity and understanding of these issues and explore the extent to which some of these may have already been experienced. A key outcome was to help Tate & Lyle to better integrate climate risks and opportunities into its current enterprise-wide risk management framework. We formed a road map and action plan for improved alignment to TCFD with the recommended next steps and suggested time-lines for Tate & Lyle.

"The TCFDs are important to help businesses like Tate & Lyle improve their understanding of long-term climate-related risks and opportunities. But to take meaningful action, we needed to start with a better understanding of what matters most," said Rowan Adams, Executive Vice President of Corporate Affairs. "With the support of AECOM, we have not only developed a road map and action plan for improved alignment to TCFD, but also engaged our organization in finding new and innovative solutions to the climate-related challenges we face."

Embedding climate-related financial risks into strategic thinking

The slow uptake of analyzing and reporting on climate-related financial risk underlines the difficulty of the task. A key challenge is that climate risks do not fit the template of other financial risks. The TCFD touches on this when it says that climate risks are "non-diversifiable." They are not amenable to conventional risk management, which works on the basis of risk isolation and mitigation on easily manageable timescales.

At AECOM, we recognize that it is difficult to align climate risk with traditional risk measures, and that is why it is so important to bring an enhanced risk awareness into a company, building engagement and understanding from the board level down.

The time for this change is now. The world has already been through a period where companies have had to respond very fast to risk scenarios that were once thought highly unlikely. Yet the speed and flexibility of response that organizations have shown through the coronavirus pandemic have readied them to meet other extreme risks.

Our experience is that many companies have the ambition to innovate around climate action. There are clear competitive opportunities in products, processes and at a deeper level in becoming different kinds of businesses. The challenge is converting the ambition into action.

Meeting that challenge means understanding and quantifying climate-related financial risks, mitigating them, and harnessing opportunities. This will be the road for successful firms to 2030 and beyond.

> "In June this year, G7 finance ministers also called for greater coordination on mandatory disclosures, and there are signals that an international agreement may be forthcoming."

Diyar Al Muharraq, Bahrain

04 Reference articles

IN BRIEF

Lusail Expressway, Qatar

Procurement routes

All clients expect projects to be delivered on time and within budget, with an agreed level of quality and with the risk professionally managed by their management and consultant teams.

However, most clients and construction professionals have experience of at least one project that was not delivered to the budget, time or quality levels expected. This is why the right procurement strategy, one that is considered robust, efficient, value-based and balances risk and control against the competing project objectives of cost, time and quality, is key to a successful project outcome.

AECOM has developed strategies for the delivery of projects that we know work, successfully delivering hundreds of projects over our long history. New and existing developers have the opportunity to learn from this knowledge and maximize the value from their time, cost and quality mix, whilst adhering to a process that increases the likelihood of their projects being successfully procured by the team involved.

Studies conducted with our key clients who regularly undertake development work have shown that projects can be delivered for 5-10 per cent less cost when procured correctly with no impact on quality or time.

So what is the right procurement approach for your projects?

Which funding strategy, funding partner, team behaviours, attitudes, communication channels, budget and program delivers the best approach, and how can we best combine these to lead our clients to ultimate success?

> “The right procurement strategy, one that balances risk and control against the competing project objectives of cost, time and quality, is key to a successful project outcome.”

Ahmed Bin Ali Stadium - Al Rayyan, Qatar

AECOM's management of the procurement process

AECOM offers important early advice to help determine the right procurement approach, adding value throughout the building process. This understanding of our clients' time, cost and quality requirements maximizes the value we can offer. Some of the procurement strategies followed in the industry are listed below, but the real challenge is selecting the right approach when considering an individual client and/or project need.

Traditional lump sum

The design by the client's consultants is completed before contractors tender for and then carry out the construction. The contractor commits to a lump sum price and a completion date prior to appointment The contractor assumes responsibility for the financial and program risks for the carrying out of the building works, whilst the client takes responsibility and accepts the risk for the quality of the design and the design team's performance. The client's consultant administers the contract and advises on aspects associated with design, progress and stage payments, which must be paid by the client. A variant on this is a traditional re-measured contract, where the tendered BOQ quantities are re-measured (either periodically or at the end of construction) and the contract price is adjusted accordingly based on the contractual rates for the revised quantities.

Accelerated traditional

As per traditional lump sum, but procured in the market place before being fully designed (normally 80-85 per cent designed), and leaving more simple elements of the building to be procured once the contractor has been appointed. It is important to understand how a client procures the remaining elements of work with a contractor under this approach, and to design out those areas that carry inherent risk early in the process. It may also involve the procurement of an early works package for enabling and/or piling works.

Two stage

A contractor is invited to become part of the project team in stage one, usually by way of a pre-construction fee or commitment to preliminaries and mark-up percentage. They jointly procure the project with the client, until such time that a second stage lump sum offer can be agreed, which should be before construction begins on site. An understanding of the original appointment and the subsequent framework, under which the second stage is agreed, are the important aspects of this approach, as well as working with transparency and trust preventing an early commitment to a full scheme that a client cannot afford.

Design and build

Detailed design and construction are both undertaken by a single contractor in return for a lump sum price. There are variants on this option depending on the degree to which initial design is included in the client's requirements. Where a concept design is prepared by a design team employed directly by the client before the contractor is appointed (as is normally the case), the strategy is called develop and construct. The contractor commits to a lump sum price, for completion of the design and the construction and to a completion date, prior to their appointment. The contractor can either use the client's concept design to complete the design or use their own scheme to finalize it within the employers requirements set. With design and build it is important to design out or specify in detail those parts of the building the client wants to see perform a particular function or provide a particular visual impact.

Management contract

Design by the client's consultants generally overlaps with the construction. A management contractor is appointed early to tender and let elements of work progressively to subcontractors and specialists work packages. The contracts are between the management contractor and the trade contractors, rather than between the client and sub-contractors. The management contractor will not carry out construction work, but is employed to manage the process. The management contractor, in theory, assumes responsibility for the financial (and program) risks for the works, but in reality this is normally diluted by the terms of the contract so their liability is similar to that of a construction manager.

Design, manage and construct

Similar to the management contract, with the contractor also being responsible for the production of the detailed design or for managing the detailed design process.

Turnkey contract

A form of a design and build contract in which a single contractor or developer is responsible for all services, possibly also including finance. Under a turnkey project, the client enters into a contract with one party to deliver the entire project. The project is handed over once it is complete and fully operational. The client is normally not involved in any of the decisions throughout the building process. There are several variations of 'turnkey' contracts, including Engineer-Procure-Construct (EPC), Build-Own-Lease-Transfer (BOLR), Design-Build-Operate-Transfer (DBOT), or PFI.

Engineer, Procure and Construct (EPC)

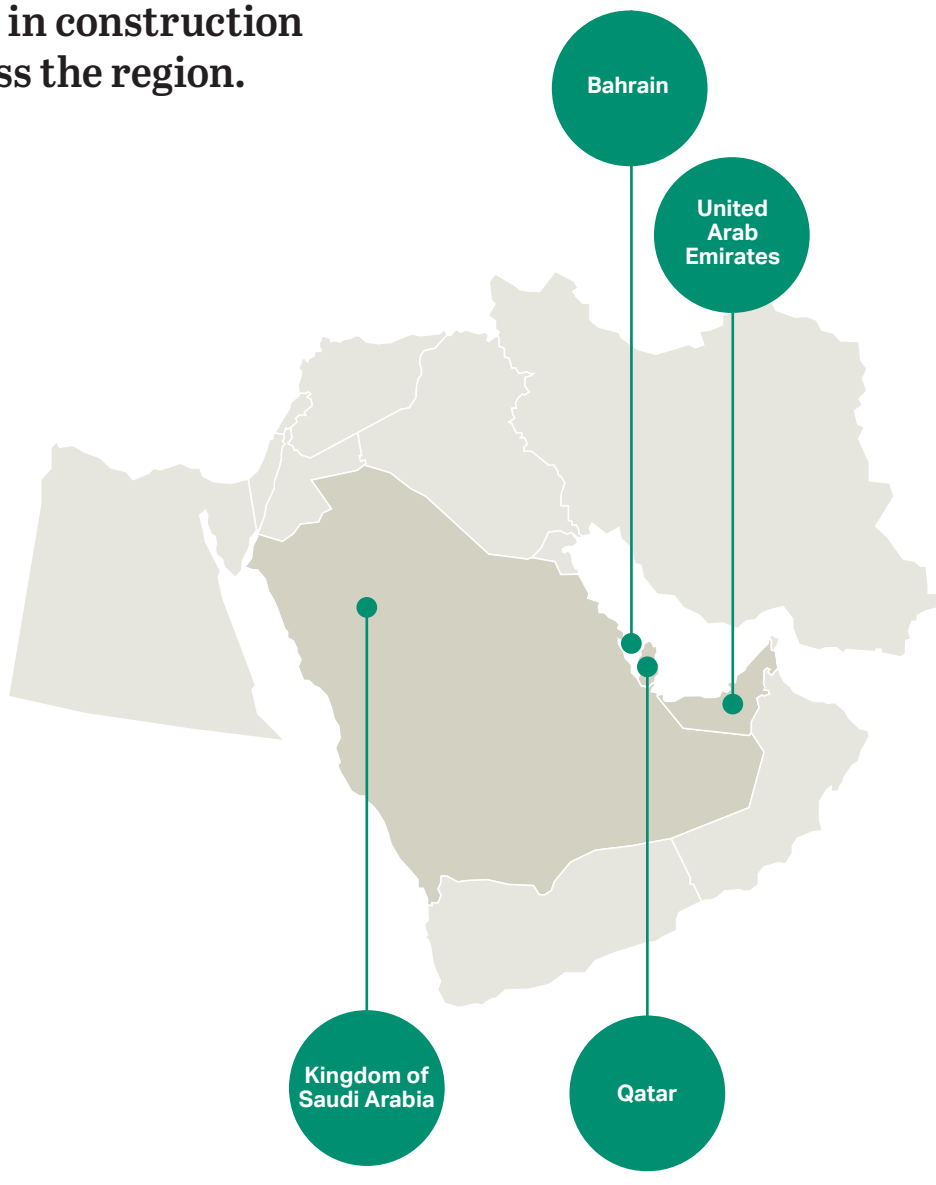
EPC is a form of "turnkey" contract. This form of procurement places risk in the right hands and offers solutions to clients' engineering requirements from those specialized to meet the performance requirements set by a client team. Many of the large utility companies procure work in this way, bringing high levels of certainty from the supply chain which helps to achieve business critical benefits over the long-term.

Public Private Partnerships (PPP)

A detailed and complicated form of procurement used predominantly for public services when the private sector feels it is advantageous to design, build, finance and operate a particular service or building type. It is becoming more popular in the Middle East as a way to limit public sector spending, whilst meeting the demands of a growing population. AECOM has been involved with PPPs for over 20 years. We have successfully completed many projects worldwide and use this global knowledge to benefit clients locally.

Middle East forms of contract

This section considers the different forms of contract used in construction across the region.



Bahrain

Government work in the Kingdom of Bahrain is undertaken using a bespoke suite of contract forms that were issued in 2009.

Private developers predominantly use the FIDIC Conditions of Contract for Construction, the 1999 edition of the 'red book', which is well understood in the local market, but often heavily amended for specific use.

Most of the work completed in Bahrain is under a traditional lump sum form of contract, where the design is completed upfront and price agreed with a contractor before work begins on site.

Design and build and two-stage procurement are in use across the Kingdom but are not considered to be the industry norm. As more international private developers have started working in Bahrain, with time constraints as their main driver, the market has adjusted to accommodate this demand. Design and build contracts, however, are not routine. This is largely due to the Council for Regulating the Practice of Engineering Professions (CRPEP) restrictions on contractors undertaking in-house design which necessitates the novation of the client's architect or a subconsultant appointment.

Kingdom of Saudi Arabia

Construction contracts in the private sector are generally based on FIDIC forms of contract, and are amended to suit the particular conditions for each project.

Employers prefer lump sum versus remeasured contracts, and normally exercise great control in the administration of the construction process by imposing various restrictions on the engineer's (consultant) authorities under the contract. All contracts are subject to Saudi laws where Islamic Sharia law is the prime source of legislation. Litigation and arbitration are both available for resolution of disputes in the private sector.

Within the public sector, however, construction contracts are based on the Standard Conditions for Public Works, which are amended to suit particular projects. These conditions are generally based on those given in the 4th edition of the FIDIC Conditions of Contract for Works of Civil Engineering Construction, the FIDIC 4 'red book', but with greater control given to the employer for the administration of the contract.

All public work contracts are let on a remeasured basis and are subject to the Saudi Government Tendering and Procurement Regulations, as issued by royal decree. It is also noted that several of the large scale developments planned have aggressive schedule targets, and as such there is also a growing appetite for the design and build form of contract, with these developments.

Diriyah Gate, KSA

Qatar

In Qatar, the most common forms for building works are those used by the PublicWorks Authority (PWA) departments through the Ministry of Municipality and Environment (MME) and the Qatar Petroleum Company (QP) forms, or FIDIC based amended bespoke forms.

The contracts are generally on a fixed price lump sum basis, utilizing bills of quantities or specifications and drawings, however, the design and build route is becoming more prevalent in the market. The contracts are often biased towards clients, wherein the contractor buys all the project risks for an increased initial price, however, such contracts are generally administered in a reasonable manner.

A high proportion of private sector projects utilize a bespoke form based on the FIDIC forms of contract, such contracts are generally fixed price lump sum which follows the general theme of most contracts in the state.

The Public Works Authority (Ashghal) utilize an in-house bespoke contract which was updated in 2018 to become more contractor-friendly with a greater share of risk. The updated suite is now tailored to a particular procurement route more suitable to the individual project needs. This approach should reduce the volume of project specific amendments included in tenders.

Major international projects frequently use a more traditional FIDIC forms (typically the 1999 version) with amendments to dispute resolution clauses and removal of DAB provisions.

Before any contract is awarded, there are commonly several rounds of negotiation, during which the price and other contractual terms can be modified to respond to a reduction in contract price.

“Before any contract is awarded, there are commonly several rounds of negotiation, during which the price and other contractual terms can be modified to respond to a reduction in contract price.”

Contract 2 - Local roads and drainage, Doha, Qatar

United Arab Emirates

Construction contracts in the UAE are predominantly based upon the FIDIC forms of contract.

Large-scale developers and major repeat clients in the region generally now develop and utilize bespoke forms of contract, tailored to each individual client.

Such contracts generally use the FIDIC 4 'red book' form as a basis, amended to a greater or lesser degree depending upon the risk profile of each client. This also applies to works procured by Dubai Municipality. Abu Dhabi Municipality, however, bases contracts on a modified FIDIC 3 form, taken from the 3rd edition of the FIDIC conditions of Contract for Works of Civil Engineering Construction.

Contracts based on the 1999 'red book' are often used in the UAE, but in general, the market remains firmly rooted in the FIDIC 4 form.

Civil works' contracts within the UAE are mostly procured on a re-measurable basis, whereas building works will generally be based on a fixed price lump sum.

However, there are exceptions. More and more clients are procuring projects using a fast-track approach and will therefore incorporate a re-measurable element, reflecting those parts of the design that are incomplete at tender stage.

There is also a significant increase in appetite for the use of design and build forms of contract, as clients intend to transfer a large share of the risk on to the contractors, as well as seeking overall project schedule savings due to earlier procurement being enabled.

> "Civil works contracts within the UAE are mostly procured on a re-measurable basis, whereas building works will generally be based on a fixed price lump sum."

Al Raha Beach Development, Abu Dhabi, UAE

Building regulations and compliance

This section outlines the procedures for obtaining building permission across the region. AECOM's project management team is vastly experienced in the procedures for building permits internationally and locally and is able to guide and oversee this process.

Zakat Tax and Customs Authority, KSA

Bahrain

Procuring a municipal building permit in Bahrain is now completed through the on-line portal, Benayat, over a seven-stage process:

Stage one
Prepare drawings

The client must engage a consultant to prepare the necessary architectural and engineering drawings and documents for the next stages of submission. It is generally sufficient to include simple outline plans, cross-sections to indicate overall heights and an area statement.

Stage two
Obtain pre-approval

Certain projects will require a pre-approval from the Urban Planning Development Affairs, Road, Planning and Design Directorate (RPDD), Civil Aviation Authority and other authorities. Specific criteria is listed out within the online portal and should the project fall under any of the requirements, then the pre-planning approval is required.

Stage three
Third party checker

Before the building permit submission and after the pre-approval, if required, the building permit package is to be submitted to a third party engineering firm to review and confirm compliance with the building code and application criteria. The reviewing firm must be of a similar grade to the submitting firm and must be registered with the Council for Regulating the Practice of Engineering Professions (CRPEP). A full list of firms is provided on the Benayat portal.

Stage four
Building permit application and third party declaration

Upon agreement with the third party, the documents are to be uploaded to the online network. The third party must, within seven days, validate the application online to allow the process to move to the Government entity review.

Stage five
Government entities review

Once the submission is made and the third party validates, the respective Government entities will review and provide any conditions. The main authorities involved at this stage are the Municipality, Sanitary Engineering Planning and Projects Directorate (SEPPD) and the Electrical Distribution Directorate (EDD).

Stage six
Fee payment

Once the submission has been reviewed and there are no objections/non-conformities, the municipal charges must be paid for the following elements:

1. Building Permit Fees.
2. Building Permit Insurance Deposit.
3. Infrastructure Fees (if applicable).
4. Civil Aviation Fees (if applicable).

Stage seven
Issue of building permit

Upon payment of the fees the building permit, along with any conditions, will be issued electronically via the Benayat system for works to proceed.

Application audit

Within two weeks of issuing the building permit, it shall be reviewed by the authorities audit team. The audit team shall inform the engineering office to resubmit or modify the drawings if any changes are required to be made to meet the relevant building code standards.

Kingdom of Saudi Arabia

Obtaining a building permit in the Kingdom of Saudi Arabia varies from region to region, however, they tend to follow the same basic principles. The various procedures and approvals from the main municipality, the branch municipality and the fire department need to be obtained. Obtaining these approvals typically takes between three to four months depending on the nature and size of the building/project.

The following is a general outline of the steps needed to obtain a building permit:

Stage one

Obtaining a letter from the main municipality

A letter from the owner is submitted to the main regional municipality, along with a copy of the land deed. The municipality checks the masterplan of the area to ensure the suitability of the plot for the construction of a building. The municipality then writes a letter to the branch municipality of the area where the plot is located. This process takes five days and does not incur a charge.

Stage two

Obtaining a preliminary location permit from the branch municipality

The owner submits a copy of the letter obtained previously from the main municipality to the branch municipality, requesting an inspection of the plot to ensure that the plot length, width and total area are as indicated on the deed. The branch municipality then issues an approval to use the land. This process takes five days and does not incur a charge.

Stage three

Obtaining approval from the fire department

The branch municipality writes to the fire department, or civil defense, to obtain its approval of the plan submitted by the owner for the fire-alarm and fire-fighting systems. The fire department approves these plans and sends them back to the municipality. This process takes ten days and does not incur a charge.

Stage four

Obtaining a final building permit

The branch municipality issues a building permit and sends it to the main municipality for approval, which is given dependent on the nature of the building. The owner can collect the permit from the main municipality after one to three months. The cost of this permit is SAR 1,200.

King Abdullah Financial District, KSA

Qatar

Compared with many other countries, the planning and building approval process in Qatar is relatively clear and structured. Land ownership, other than by Qatari nationals and the state, is still extremely limited. The key process in securing development rights is obtaining a land title or 'PIN', since without it all other permits and applications cannot be commenced. Once the land is secured, the project masterplan is submitted for approval to the Planning Department and local municipality offices.

Stage one

DC1 approval

General overviews and strategies for the utilities and primary infrastructure are submitted to the relevant utility service providers for comment. During this process, each department generally issues a series of reference numbers that are then used as the file number for all future submissions.

The culmination of this round of submissions is the DC1 approval. As the design develops, a second round of submissions are made to the same utility departments for final approval. In addition, a submission is made to the Qatar Civil Defense (QCD) department who review the fire and life safety aspects of the project.

Stage two

DC2 approval

Depending upon the scale and nature of the project, separate traffic studies may be required and these would be submitted to the Road Affairs Department for approval. Qatar Civil Defense may request modifications to ACMV, FF/FA at this stage.

Stage three

Final stage/building permit

Once the DC2 approval is secured a further set of standard forms are circulated with a consolidated set of documents for final signing and approval. These documents constitute the building permit.

As a general guide the whole process usually takes at least 80 days (duration for private sector is stated in the KPI document issued by MME in relation to the corresponding size and type of the project), depending upon the quality of the submission, although in practice it often takes much longer due to comments from different departments and progressive design revisions.

During the whole of this process, it is generally not advisable to revise or modify any submission as it may delay the approval process.

All submissions must be in Arabic, or bilingual, and should been endorsed by locally registered and approved design companies. International companies cannot make these submissions by themselves.

There are some parts of Qatar that are exempt from the building permit approval process. These are generally related to oil and gas production facilities.

Recently, a number of revisions have been made to the design standards of buildings, in particular, high-rise structures. These address issues such as fire safety, refuge areas, the use of lifts in the event of fire, and the nature and extent of façade glazing.

Fit out and refurbishment projects now follow a similar DC1 and DC2 process, a change from the requirement to obtain a maintenance permit before work commenced. The approval process is now under the control of the Ministry of Municipality and Approvals.

This submission must be made by a registered local consultant and failure to do this can significantly delay the approval and permitting process. The statutory approval process comprises multiple stages that in turn, dictate the program parameters.

The stages are as follows:

Opening of the file
Submission of MME documents/forms and architectural preliminary drawings.

DC1
Fire/life safety (consists of egress paths, occupancy load, emergency lighting, fire ratings, etc.) and Kharamaa drawings.

DC2
Fire fighting, fire alarms, ACMV (upon request), emergency lighting and Kharamaa loads confirmation (if requested by MME).

Building permit
MME forms for construction.

Following approvals from all of the required stages, and receipt of the municipality building permit, it is only then that officially marks the time works may then commence on site. However, at the landlord's discretion, mobilisation and demolition works may commence.

The main risks associated with civil defense approvals and municipality building permits are as follows:

- Submission of incorrect information, resulting in rejection of the application.
- Administrative delays within the Civil Defense Department.
- Public holidays and governmental shutdowns.

Hamad International Airport, Qatar

United Arab Emirates

The following is a general outline of the procedure for obtaining a building permit in the UAE, but there are many further obligations and procedures to be completed within each of the stages. For example, stage three of the building permit application requires no less than 15 different forms, documents and separate approvals to be submitted as part of the application.

It is the responsibility of the construction contractor or lead consultant to obtain the building permit, although all applications must be signed by locally registered consultants.

Stage one

Submitting the preliminary application

The applicant submits a preliminary application to the relevant municipality or statutory authority and pays a deposit.

Stage two

No Objection Certificates (NOC)

These are obtained from various governmental and municipal departments including; civil defense, the fire department, drainage, communication, water and electricity, civil aviation, oil and gas, coastal and military.

Stage three

Submitting the building permit application

The full building permit application, including all NOCs, is submitted to the relevant municipality or statutory authority.

Stage four

Obtaining the building permit

On approval, the applicant collects the building permit and applies for a demarcation certificate.

Stage five

Obtaining the building completion certificate

NOC's are to be obtained from various governmental and municipal departments, this is so you can submit to the relevant municipality or statutory authority for the final building completion certificate application, along with all supporting documents.

CLYMB, Abu Dhabi, UAE

05 Reference data

IN BRIEF


SOULFUL
PLACES.
ENRICHED
LIVES.

International building cost comparison

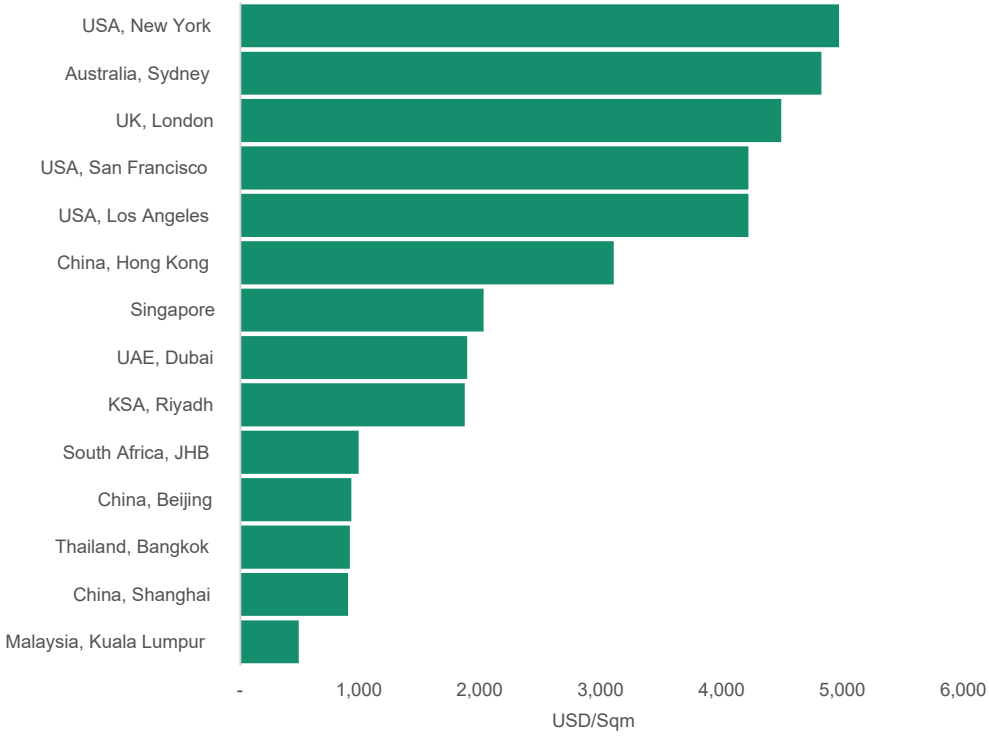
The international cost data shown is a comparison of local construction costs converted to US Dollars to enable differentiation.

The building costs, for their respective asset types, are averages based on local specifications. The actual cost of a building will depend on among other things, such as unique site conditions, design attributes and applicable tariffs. In addition, the standard for each building varies from region to region, which may have a significant impact on costs.

Costs are subject to considerable variations due to factors such as:

- Local market conditions
- Complexity of project
- Commodity price movements
- Building specifications
- Exchange rates
- Contractors appetite for securing work
- Contractual risk apportionment

Average building cost for a standard residential high-rise



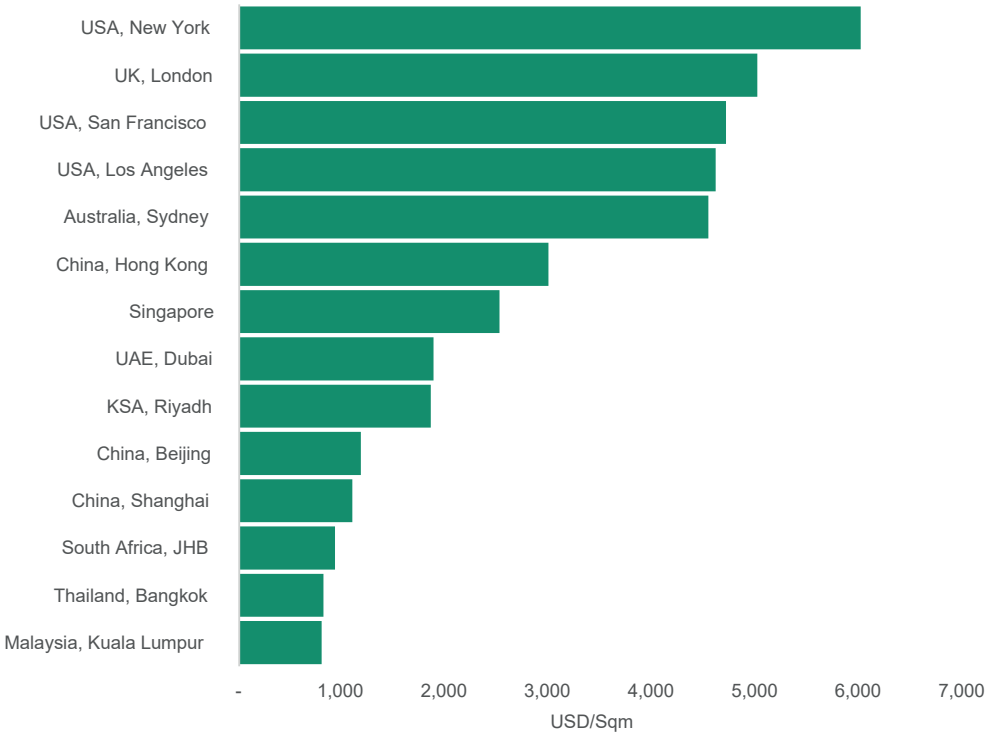
Average building costs (USD/sqm)

Building type	**Sydney** Australia	**Hong Kong** China	**Beijing** China	**Shanghai** China	**Kuala Lumpur** Malaysia	**Singapore** Singapore	**Johannesburg** South Africa	**Bangkok** Thailand	**Dubai** UAE	**Los Angeles** USA	**San Francisco** USA	**New York** USA	**London** UK	**Riyadh** KSA
Average multi-unit high-rise	4,805	3,086	916	889	482	2,011	976	903	1,875	4,200	4,200	4,950	4,473	1,855
Luxury unit high-rise	6,589	4,281	1,711	1,644	923	3,469	1,204	1,355	2,250	5,390	5,300	6,300	6,271	2,240
Individual prestige houses	6,864	5,973	971	973	1,100	3,268	1,269	1,445	-	5,100	5,400	5,850	6,222	-
(As of Sept 2021)	**AUD**	**HKD**	**CNY**	**CNY**	**MYR**	**SGD**	**ZAR**	**THB**	**AED**	**USD**	**USD**	**USD**	**GBP**	**SAR**
US $1 =	1.38	7.79	6.45	6.45	4.18	1.36	15.05	33.66	3.67	1.00	1.00	1.00	0.74	3.75

Source: AECOM

Note: Prices exclude land, site works, professional fees, tenant fitout and equipment. Rates exclude GST/VAT. Costs based on Q3 2021. Exchange rates to USD as of Q3 2021.

Average building cost for standard high-rise offices



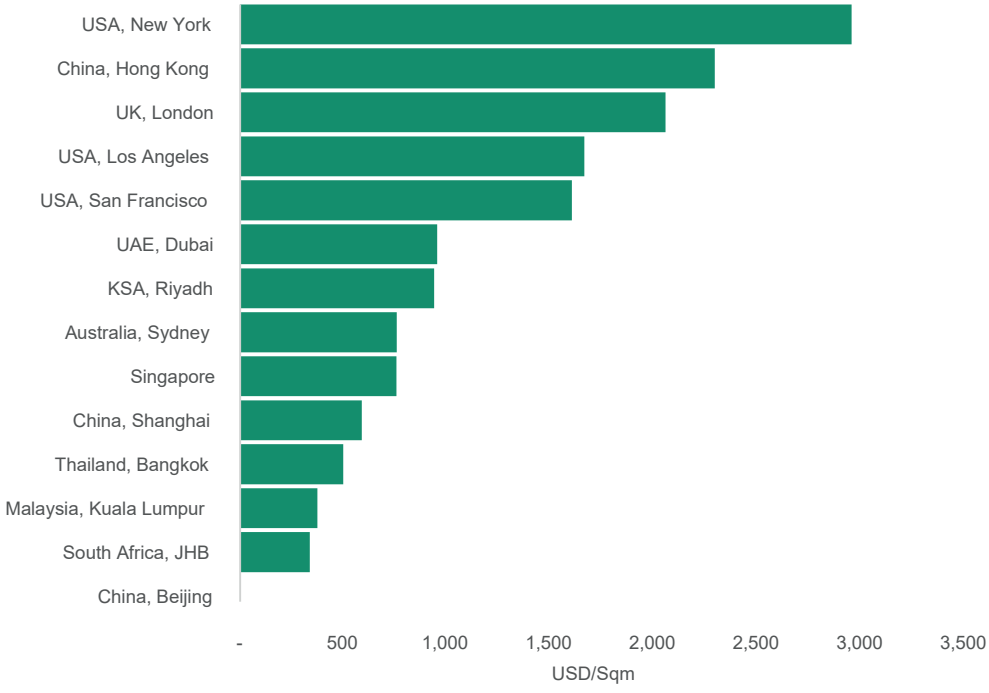
Average building costs (USD/sqm)

Building type	Sydney Australia	Hong Kong China	Beijing China	Shanghai China	Kuala Lumpur Malaysia	Singapore Singapore	Johannesburg South Africa	Bangkok Thailand	Dubai UAE	Los Angeles USA	San Francisco USA	New York USA	London UK	Riyadh KSA
Average standard offices high-rise	**4,530**	**2,987**	**1,174**	**1,090**	**796**	**2,513**	**924**	**813**	**1,875**	**4,600**	**4,700**	**6,000**	**5,002**	**1,850**
Prestige offices high-rise	6,589	3,683	1,608	1,761	1,191	3,117	1,190	994	2,250	5,060	5,000	6,450	6,183	2,200
Major shopping center (CBD)	4,599	4,281	1,460	-	830	3,418	911	813	1,725	3,800	4,000	4,400	5,453	1,750
(As of Sept 2021)	**AUD**	**HKD**	**CNY**	**CNY**	**MYR**	**SGD**	**ZAR**	**THB**	**AED**	**USD**	**USD**	**USD**	**GBP**	**SAR**
US $1 =	1.38	7.79	6.45	6.45	4.18	1.36	15.05	33.66	3.67	1.00	1.00	1.00	0.74	3.75

Source: AECOM

Note: Prices exclude land, site works, professional fees, tenant fitout and equipment. Rates exclude GST/VAT. Costs based on Q3 2021. Exchange rates to USD as of Q3 2021.

Average building cost for a light duty factory



Average building costs (USD/sqm)

Building type	Sydney Australia	Hong Kong China	Beijing China	Shanghai China	Kuala Lumpur Malaysia	Singapore Singapore	Johannesburg South Africa	Bangkok Thailand	Dubai UAE	Los Angeles USA	San Francisco USA	New York USA	London UK	Riyadh KSA
Light duty factory	**755**	**2,290**	**-**	**587**	**371**	**754**	**335**	**497**	**950**	**1,660**	**1,600**	**2,950**	**2,051**	**935**
Heavy duty factory	-	-	-	-	523	955	381	768	1,475	2,080	2,100	3,870	3,519	1,268
Multi-storey car park	1,098	1,643	-	470	286	-	280	497	700	1,680	1,600	1,550	1,005	-
District hospital	7,276	5,475	-	1,594	852	-	1,855	-	2,975	7,800	7,450	9,100	5,053	2,350
Primary and secondary schools	2,814	2,588	-	1,090	304	-	510	-	1,735	4,800	4,700	4,850	3,237	-
(As of Sept 2021)	**AUD**	**HKD**	**CNY**	**CNY**	**MYR**	**SGD**	**ZAR**	**THB**	**AED**	**USD**	**USD**	**USD**	**GBP**	**SAR**
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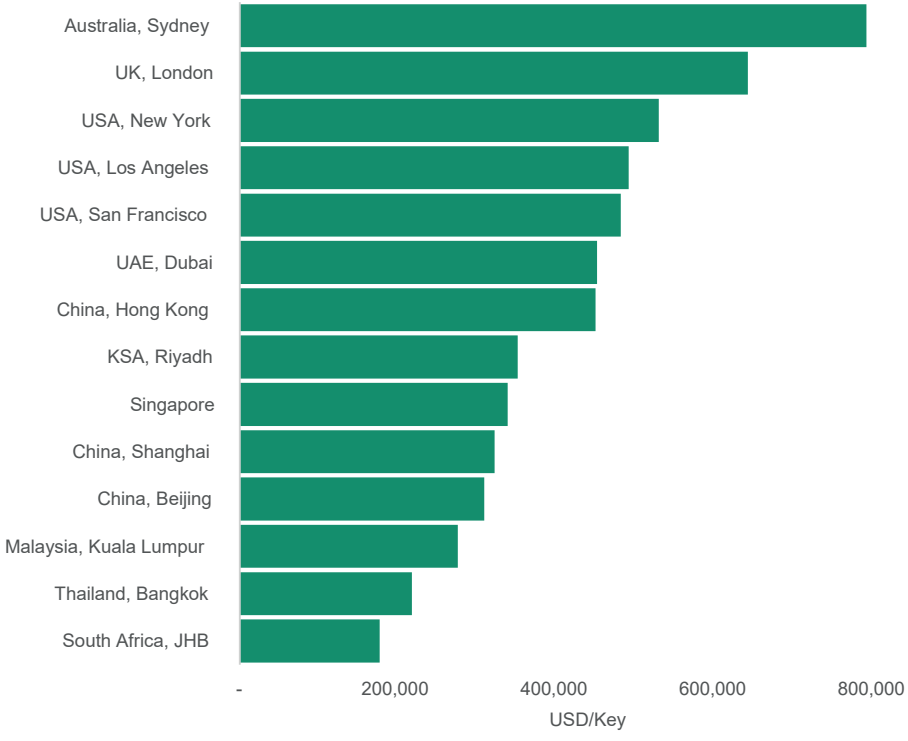
Source: AECOM

Note: Prices exclude land, site works, professional fees, tenant fitout and equipment. Rates exclude GST/VAT. Costs based on Q3 2021. Exchange rates to USD as of Q3 2021.

Average building cost for a five-star luxury hotel



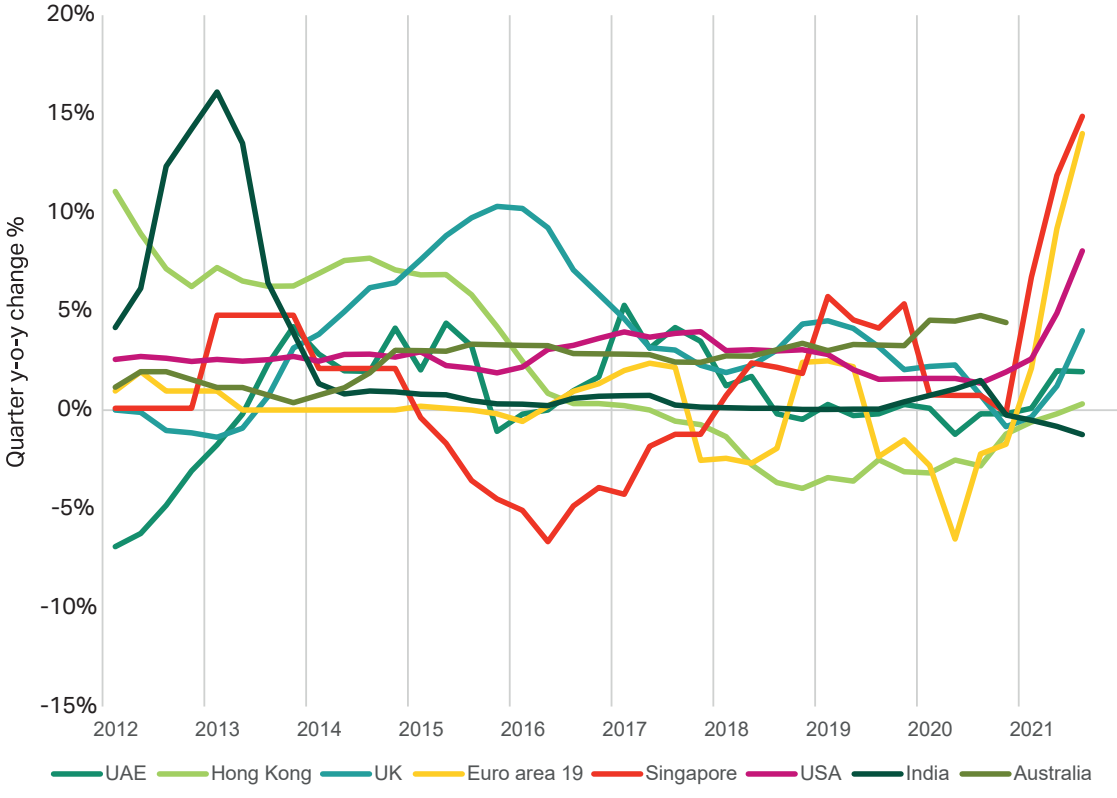
Average building costs (USD/key)

Building type	**Sydney** Australia	**Hong Kong** China	**Beijing** China	**Shanghai** China	**Kuala Lumpur** Malaysia	**Singapore** Singapore	**Johannesburg** South Africa	**Bangkok** Thailand	**Dubai** UAE	**Los Angeles** USA	**San Francisco** USA	**New York** USA	**London** UK	**Riyadh** KSA
Three-star budget	377,510	209,057	-	-	151,245	59,821	86,223	56,451	100,000	84,000	84,000	87,000	105,564	90,000
Five-star luxury	**789,340**	**447,979**	**307,926**	**320,746**	**274,383**	**337,309**	**176,024**	**216,773**	**450,000**	**490,000**	**480,000**	**528,000**	**640,125**	**350,000**
Resort style	-	-	508,890	-	214,152	224,705	-	261,934	650,000	305,000	300,000	300,000	393,059	-
(As of Sept 2021)	**AUD**	**HKD**	**CNY**	**CNY**	**MYR**	**SGD**	**ZAR**	**THB**	**AED**	**USD**	**USD**	**USD**	**GBP**	**SAR**
US $1 =	1.38	7.79	6.45	6.45	4.18	1.36	15.05	33.66	3.67	1.00	1.00	1.00	0.74	3.75

Source: AECOM

Note: Prices exclude land, site works, professional fees, tenant fitout and equipment. Rates exclude GST/VAT. Hotel rates include FF&E. Costs based on Q3 2020. Exchange rates to USD as of Q3 2020.

International construction cost inflation



Source: Based on AECOM Indices for UK, UAE; ENR USA Construction Cost Index; Singapore Building Construction Authority, Hong Kong Architectural Services Dept (Public Sector), Euroarea Eurostat Construction Output Index, India CIDC Construction Cost Index, AIQS Building Cost Index.

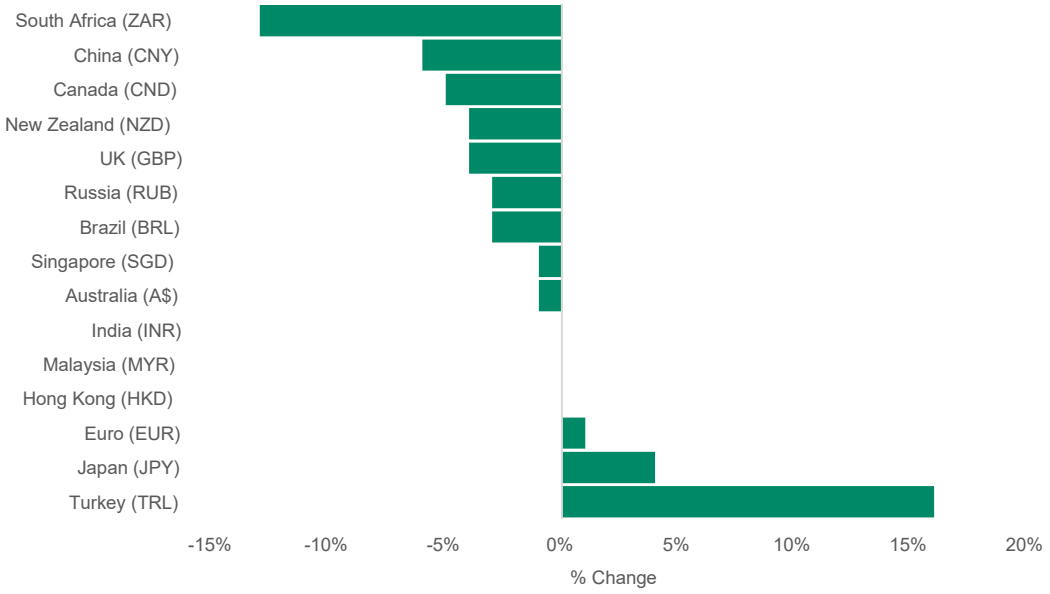
International exchange rate trends

In recent years, exchange rate movements have been significant as diverging economic performance has led to many major currencies experiencing significant shifts against the US Dollar. The Forex rate illustrates a country's economic stability with leading factors that can influence fluctuations and those that are constantly analyzed, including:

- Interest rates
- A Country's current account balance
- Government debt
- Political stability (Brexit, trade uncertainty and shifts, elections)
- Recessions
- Commodity markets
- International trade

Currency depreciation against the US Dollar translates into a relative drop in building costs when expressed in US Dollars, making these locations/regions relatively cheaper in US Dollar terms.

Exchange rate trends
Currency movements of the US Dollar against major currencies
Q3 2021 compared to Q3 2020



Warner Bros. World Abu Dhabi, UAE

Middle East building cost comparison

The Middle East cost data shown is a comparison of local construction costs converted to US Dollars to enable differentiation.

The building costs, for their respective asset types, are averages based on local specifications. The actual cost of a building will depend on among other things, such as unique site conditions, design attributes and applicable tariffs. In addition, the standard for each building varies from region to region, which may have a significant impact on costs.

Costs are subject to considerable variations due to factors such as:

- Local market conditions
- Complexity of project
- Commodity price movements
- Building specifications
- Exchange rates
- Contractors appetite for securing work
- Contractual risk apportionment

Average building cost by asset type

Building cost (USD/sqm)	UAE (Dubai)		KSA (Riyadh)		Qatar (Doha)		Bahrain (Manama)	
Typology	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
Residential								
Low-rise	950	1,500	800	1,200	1,090	1,570	800	1,350
Medium-rise	1,000	1,600	1,070	1,470	1,200	1,815	1,050	1,600
High-rise	1,500	2,250	1,470	2,240	1,750	2,530	1,450	2,000
Villas	1,100	2,250	990	1,335	1,300	2,500	650	1,350
Commercial								
Low-rise office (shell & core)	1,100	1,450	935	1,280	1,275	1,570	1,050	1,450
Mid-rise office (shell & core)	1,250	1,850	1,150	1,550	1,550	1,915	1,200	1,600
High-rise office (shell & core)	1,500	2,250	1,440	2,535	1,740	2,455	1,450	2,050
Fit out-basic	950	1,550	700	950	1,150	1,765	650	950
Fit out-medium	1,500	1,950	1,250	1,850	1,670	2,160	950	1,200
Fit out-high	1,950	2,550	1,850	2,400	2,300	2,900	1,200	1,600
Retail								
Community	1,300	1,630	990	1,255	1,495	1,820	1,050	1,350
Regional mall	1,350	1,700	1,200	1,735	1,455	1,865	1,200	1,600
Super regional mall	1,500	1,950	1,415	2,135	1,725	2,145	1,450	1,850
Industrial								
Light duty factory	750	1,150	650	950	885	1,030	800	1,050
Heavy duty factory	1,100	1,850	900	1,500	1,305	1,880	950	1,200
Light industrial unit	600	850	500	750	735	885	650	950
Data Centers								
<10Mw Tier 3 (*Based on AED/kW(IT)	11,000	15,000	11,000	15,000	12,100	16,500	10,500	14,250
>10Mw Tier 3 (*Based on AED/kW(IT)	7,500	11,500	8,000	11,500	8,800	12,650	7,250	11,000
Hotel								
Budget	1,700	1,950	1,470	1,735	1,900	2,200	1,550	1,800
Mid-market	2,000	2,650	1,815	2,270	2,400	3,150	1,650	2,250
Up-market	2,700	3,550	2,335	3,600	3,300	4,315	2,100	2,650
Resort	3,200	3,750	2,800	4,670	3,855	4,555	2,500	3,350
Car parks								
Multi-storey	550	850	590	855	660	930	450	650
Basement	815	1,140	670	1,015	970	1,250	650	1,000
Other								
Schools — primary, secondary, academy	1,370	2,100	1,150	1,470	1,585	2,160	1,400	1,800
Healthcare — district hospital	2,200	3,750	1,950	2,750	2,605	4,100	2,500	3,050
Exchange rate to 1 USD	AED	3.67	SAR	3.75	QAR	3.64	BHD	0.37

Source: AECOM

Note:
1. All costs are based on Q3 2021.
2. Relative cost of construction are based on typical build costs in USD. Influence of exchange fluctuations, unique site conditions, design attributes and applicable tariffs must be considered when comparing actual projects.
3. Relative costs are based on an average across all sectors.
4. For typology definitions, inclusions and exclusions see page Asset Type - basis, inclusions and exclusions.
5. No investment or other business decision should incorporate the rates in the above table without first contacting AECOM for further information/clarification.
6. The KSA – Riyadh building costs are not representative of current or future assets associated with 'gigaprojects' under development.

Asset type: basis, inclusions and exclusions

Asset class	Cost inclusions	Cost exclusions
Residential	– Fit out works – MEP services installations – Lift services installations	
Commercial offices	– Internal finishes — lobby and core areas only – Fit out works — lobby and core areas only – MEP services installations — lobby and core areas only – Lift services installations	– Internal finishes to offices – MEP services installations to offices – Active IT and phone equipment
Fit out (commercial offices)	– Works to fit out area only – Fit out works — architectural – Fit out works — MEP services – Specialist installations (AV, IT, security) – FF&E	– Active IT and phone equipment
Retail	– Front of house fit out – Kitchen and laundry equipment – Active IT equipment	– Tenant fit out – Strip retail developments
Industrial (light duty factory)	– Warehouse/distribution type factory – Internal services – FF&E	– Storage/racking systems – IT and CCTV active equipment – OS&E – Production, process and laboratory equipment – Waste water treatment plant, compressed air plant – Process water and drainage systems – N+1/2 redundancy – Humidity/environmental control/conditioning other than standard air conditioning – Ultra flat slabs
Data centers		– Active equipment – FF&E – Utilities outside the building outline – Modular construction (based on one complete data center)
Hotel	– Fit out – Kitchen and laundry equipment – Active IT equipment	– Pre-operating expenses – Client soft costs – OSE
Healthcare, education	– Fixed fit out works only	– All loose fit out and ICT – All medical equipment

Note: All costs are based on Q3 2021

General notes	General cost inclusions	General cost exclusions
– The building costs for the respective asset types are averages based on competitive tenders analysed by AECOM. It must be understood that the actual cost of a building will depend on the design and many other factors and may vary from the figures shown. – Due to the volatile nature of the current market, it is possible that tenders will be received outside these ranges. Professional advice should be sought for specific projects. – The standard for each building varies from region to region. – General and specific cost inclusions and exclusions are listed below. – Relative costs of construction are based on typical build costs in USD. Influence of foreign exchange fluctuations, unique site conditions, design attributes and applicable tariffs must be considered when comparing actual projects.	– Construction works – Main contractor preliminaries and OH&P	– External works and landscaping – Site infrastructure – Enabling works – Swimming pools – Basements podiums and car parks – Contingencies – Undefined provisional sums – Utility connection charges – Statutory fees and charges – Professional fees – Client direct costs – Land acquisition – Finance charges – LEED silver or above – Staff accommodation – Pre-opening expenses – Mock ups – VAT

Average MEP cost by asset type

MEP cost (USD/sqm)	UAE (Dubai)		KSA (Riyadh)		Qatar (Doha)		Bahrain (Manama)	
Typology	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
Residential								
Low-rise	230	365	190	285	260	380	230	360
Medium-rise	240	405	260	375	290	450	360	500
High-rise	380	605	375	610	440	680	540	700
Villas	310	720	250	365	360	800	195	405
Commercial								
Low-rise office (shell & core)	310	435	260	385	360	470	370	510
Mid-rise office (shell & core)	380	610	355	515	470	630	470	560
High-rise office (shell & core)	470	790	450	890	540	860	660	900
Fit out - basic	290	500	210	300	350	560	240	330
Fit out - medium	480	670	400	630	530	730	300	420
Fit out - high	660	900	630	840	780	1,020	390	600
Retail								
Community	360	570	275	445	420	640	360	450
Regional mall	380	600	340	610	410	650	410	500
Super regional mall	420	690	395	755	480	750	450	590
Industrial								
Light duty factory	240	410	260	375	280	360	540	740
Heavy duty factory	390	740	365	610	460	750	670	940
Light industrial unit	180	255	205	250	220	270	330	470
Data center - Tier 3 (based on AED/kW(IT)	6,000	9,300	5,400	8,370	6,600	10,230	N/A	N/A
Data Centers								
<10Mw Tier 3 (*Based on AED/kW(IT)	6,600	9,000	6,600	9,000	7,260	9,900	6,300	8,550
>10Mw Tier 3 (*Based on AED/kW(IT)	4,500	6,900	4,800	6,900	5,280	7,590	4,350	6,600
Hotel								
Budget	480	585	415	530	530	660	470	560
Mid-market	600	830	550	710	720	980	510	680
Up-market	810	1,140	705	1,150	990	1,380	680	860
Resort	960	1,240	850	1,545	1,160	1,500	750	1,090
Car parks								
Multi-storey	120	205	130	215	150	220	80	130
Basement	220	315	185	280	260	340	180	280
Other								
Schools - primary, secondary, academy	440	680	375	470	510	690	370	490
Healthcare — district hospital	900	1,575	800	1,160	1,070	1,720	1,160	1,410
Exchange rate to 1 USD	AED	3.67	SAR	3.75	QAR	3.64	BHD	0.37

Note: All costs are based on Q3 2021.

Typical building services' standards for offices

Subject	BCO (UK) specification 2014	Bahrain specification	UAE specification	Qatar specification	Oman specification
Net : Gross ratio - typical	80 - 85%	70 - 80%	75 - 80%	70 - 80%	70 - 80%
Occupancy standards — typical	1:8 - 1:13/m²	1:10 - 1:14/m²	1:10 - 1:15/m²	1:10 - 1:14/m²	1:10 - 1:15/m²
Occupancy standards — toilets	Single sex one person to 10m² using 60/60 male/female ratio based on 120% ratio.	Single sex one person to 12m² using 50/50 male/female ratio based on 100% population.	Single sex one person to 12m² using 50/50 male/female ratio based on 100% population.	Single sex one person to 12m² using 50/50 male/female ratio based on 100% population.	Single sex one person to 12m² using 50/50 male/female ratio based on 100% population.
Heating and air conditioning internal criteria	24°C, +/- 2°C (Summer) 20°C, +/- 2°C (Winter)	24°C, +/- 2°C	24°C, +/- 2°C	24°C, +/- 2°C	24°C, +/- 2°C
Fresh air supplies	12 - 15 L/s per person	8.5 - 10 L/s per person	8.5 - 10 L/s per person	8.5 - 10 L/s per person	8.5 - 10 L/s per person
Ventilation - WCs (extract)	none stated	10 Air changes per hour	10 Air changes per hour	10 Air changes per hour	10 Air changes per hour
Lighting load allowance	10 W/m²	10 W/m²	10 W/m²	10 W/m²	10 W/m²
Small power load allowance (based upon one workspace every 10m2)	20-25 W/m²	12 - 25 W/m²	12 - 25 W/m²	12 - 25 W/m²	12 - 25 W/m²
Acoustics - open plan	NR 40	NR 40	NR 40	NR 40	NR 40
Acoustics - cellular offices	NR 35	NR 35	NR 35	NR 35	NR 35
Lighting - VDU use	300 - 500 lux	400 - 500 lux	400 - 500 lux	400 - 500 lux	400 - 500 lux
Passenger lifts - capacity	0.8	0.8	0.8	0.8	0.8
Passenger lifts - waiting time (up-peak)	< 25 seconds	< 30 seconds	< 30 seconds	< 30 seconds	< 30 seconds

Asset type: basic specification

Asset type	Residential		
Typology	Low-rise	Mid-rise	High-rise
Specification	Basic, medium and high	Basic, medium and high	Basic, medium and high
Key design characteristics			
Building height	G+1 to G+3	G+4/5 to G+20	G+20 and above
GIA	80,000 - 140,000	50,000 - 80,000	90.000 - 120,000
BUA	85,000 - 155,000	55,000 - 90,000	105,000 - 135,000
Efficiency (%)	85 - 100%	80 - 85%	70 - 80%
Units per core	1 - 2	10 - 20	4 - 6
Wall: floor ratio	0.50 - 0.80	0.45 - 0.65	0.45 - 0.55
Net to gross	80 - 100%	75 - 85%	65 - 75%
GIA per unit	200 - 450m²	90 - 200m²	145 - 165m²

Asset type	Offices		
Typology	Low-rise (shell and core)	Mid-rise (shell and core)	High-rise (shell and core)
Specification	Basic, medium and high	Basic, medium and high	Basic, medium and high
Key design characteristics			
Building height	G+1 to G+5	G+5 to G+20	G+20 and above
GIA	10,000 - 25,000	25,000 - 75,000	100,000 - 250,000
BUA	13,000 - 30,000	30,000 - 100,000	130,000 - 280,000
Efficiency (%)	70 - 85%	70 - 85%	70 - 85%
Wall: floor ratio	0.40 - 0.70	0.40 - 0.60	0.40 - 0.50
Net to gross	50 - 60%	50 - 60%	50 - 70%
Slab to slab height	4.0 - 5.0m	4.0 - 4.5m	4.0 - 4.5m
Grid spans	7 - 12m	9 - 12m	9 - 12m

Asset type	Retail		
Typology	Community	Regional	Super regional
Key design characteristics			
Finishes	Mid range	High	High
GFA (m²)	Not exceeding 30,000	30,000 - 100,000	> 100,000

Asset type	Industrial			
Typology	Light duty factory	Heavy duty factory	Light industrial unit	Data center — Tier 3
Specification	Basic	Basic	Basic	Basic
Key design characteristics				
Building height (m)	8	10	6	6
GIA	10,000	20,000	6,000	4,000
Wall : floor ratio	0.33	0.30	0.38	0.35

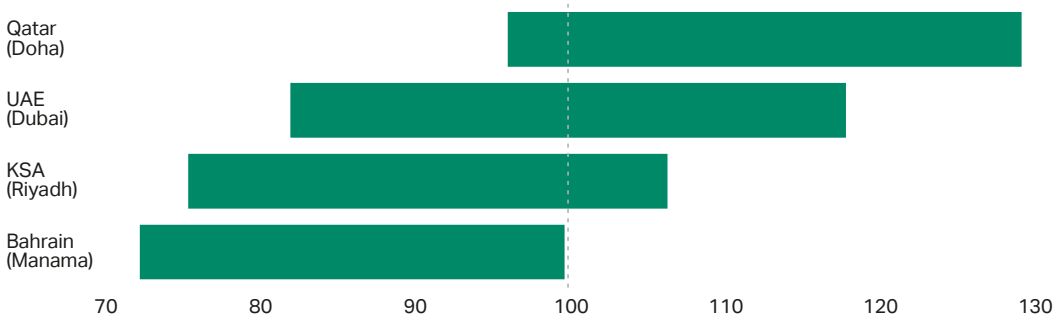
Asset type	Hotel			
Typology	Budget	Mid-market	Up-market	Resort
Specification	Basic	Mid range	Luxury	High end
Key design characteristics				
Building height	G+10	G+10	G+15	G+6
GIA	16,000 - 18,000	13,500 - 15,500	56,000 - 60,000	39,000 - 41,000
Wall: floor ratio	70%	75%	75%	55%
Functional units	350	200	350	200

Asset type	School	Healthcare
Typology	Primary/secondary academy	District hospital
Specification	Mid-range	Mid-range
Key design characteristics		
Building height (m)	10	24
GIA (m²)	21,000 - 22,000	50,000
No. of lift core	1	4
No. of stair core	9	6

Middle East relative cost of construction

The relative cost of construction is based on typical building costs in US Dollars. The influence of foreign exchange fluctuations, unique site conditions, design attributes and applicable tariffs must be considered when comparing actual projects. Relative costs are based on an average across all sectors.

Middle East relative cost of construction



Note: Relative cost of construction are based on typical build costs in USD. High and low cost factors for each building type have been calculated relative to the UAE (Dubai), where average costs equal 100. The relative cost bars plotted in the chart represent the average high and low cost factor for each country, based on the costs of the buildings included in the sample (excluding commercial fit-outs).

Doha Oasis, Qatar

Major measured unit rates

Item (Unit rates in USD)	Unit	Description	UAE (Dubai)	KSA (Riyadh)	Qatar (Doha)	Bahrain (Manama)
Excavation	m^3	"Standard/minimum specification excavation for trench foundation; depth not excessive, i.e. no greater than 1-2 m"	7	8	7	11
Disposal of excavated material	m^3	"Standard/minimum specification disposal away from site"	6	6	5	4
Filling	m^3	Imported fill	13	18	16	19
Poured concrete, reinforced	m^3	"Standard/minimum specification grade 20 or 30; superstructure, walls or slabs; reinforced "	124	140	142	159
Reinforcement	tn	"Standard/minimum specification 20mm bars"	1,115	1,400	1,049	979
Formwork/shuttering	m^2	"Standard/minimum specification superstructure standard; fair face finish to walls"	44	39	36	19
Blockwork	m^2	"Standard/minimum specification 200mm solid blockwork, usually internal walls"	36	36	36	24
Doors	no.	"Standard/minimum specification single leaf door, fire rated, timber, basic finish, usually 900mm wide, generally excluding ironmongery"	1,076	1,200	1,396	847
Tiling to floors	m^2	"Standard/minimum specification 300 x 300mm ceramic tiles"	34	67	49	27
Plaster to internal walls and ceilings	m^2	12.5mm thickness	15	12	12	10
Painting to internal walls and ceilings	m^2	"Standard/minimum specification Emulsion"	7	11	6	4
Exchange rate to 1 USD			AED 3.67	SAR 3.75	QAR 3.64	BHD 0.37

Note: All costs are based on Q3 2021.

Major material prices

Item (Unit rates in USD)	Description	Unit	UAE (Dubai)	KSA (Riyadh)	Qatar (Doha)	Bahrain (Manama)
			USD	USD	USD	USD
Cement	Ordinary Portland cement	Tonne	77	92	94	85
Sand	Sand for concreting	m³	11	12	17	22
Aggregate	19mm aggregate	m³	16	14	34	38
Ready-mixed concrete	Grade 50 (OPC)	m³	72	88	130	101
	Grade 40 (OPC)	m³	61	77	121	95
	Grade 20 (OPC)	m³	62	67	114	90
Reinforcing steel	High tensile	tn	832	872	999	688
	Mild steel	tn	798	836	829	661
Hollow concrete blockwork	100mm thick	m²	11	9	10	9
	200mm thick	m²	13	11	16	11
Structural steelwork	Mild steel grade 50 to BS 4360	tn	1,232	1,881	1,269	1,058
Timber	Hardwood	m³	851	949	911	934
	Softwood	m³	325	483	348	331
Fuel	Diesel	Litre	0.70	0.14	0.30	0.42
	Petrol Premium 95	Litre	0.69	0.58	0.34	0.53
Exchange rate to 1 USD			AED 3.67	SAR 3.75	QAR 3.64	BHD 0.37

Note: All costs are based on Q3 2021. Cost rates are indicative and represent supply only costs of the materials listed. Location factors should be applied to address geographic variations in each country. The rates are exclusive of VAT or similar, where applicable.

Mall of Oman, Oman

Labour costs

Description	Unit	UAE (Dubai) USD	KSA (Riyadh) USD	Qatar (Doha) USD	Bahrain (Manama) USD
Skilled operatives					
Concreter	Hour	5.9	6.8	6.0	6.6
Steel Fixer	Hour	5.9	7.3	6.0	6.1
Bricklayer	Hour	6.5	7.3	7.5	6.6
Carpenter	Hour	6.5	7.3	7.5	6.1
Mechanical Installer	Hour	8.4	9.5	6.9	7.2
Electrician	Hour	9.0	9.0	9.0	6.6
Laborer (skilled)	Hour	5.7	5.4	6.1	4.5
Supervision					
Foreman	Hour	11.2	12.2	12.5	9.3
MEP Foreman	Hour	12.6	15.0	12.5	9.3
Site Engineer	Month	7,013	8,933	5,480	5,514
Construction Manager	Month	11,221	16,800	12,329	11,690
Exchange rate to 1 USD		AED 3.67	SAR 3.75	QAR 3.64	BHD 0.37

Note: All costs are based on Q3 2021.
These rates (USD) are indicative and represent an all-in unit cost for each of the disciplines listed; and are
- Inclusive of: wages, salaries and other remunerations prescribed by local labour legislation; average allowances for costs of employment; recruitment; visas/permits; paid leave; travel; accommodation; health and welfare
- Exclusive of: overtime working; contractor mark-up for overheads and profit; VAT (Value Added Tax) or similar where applicable.

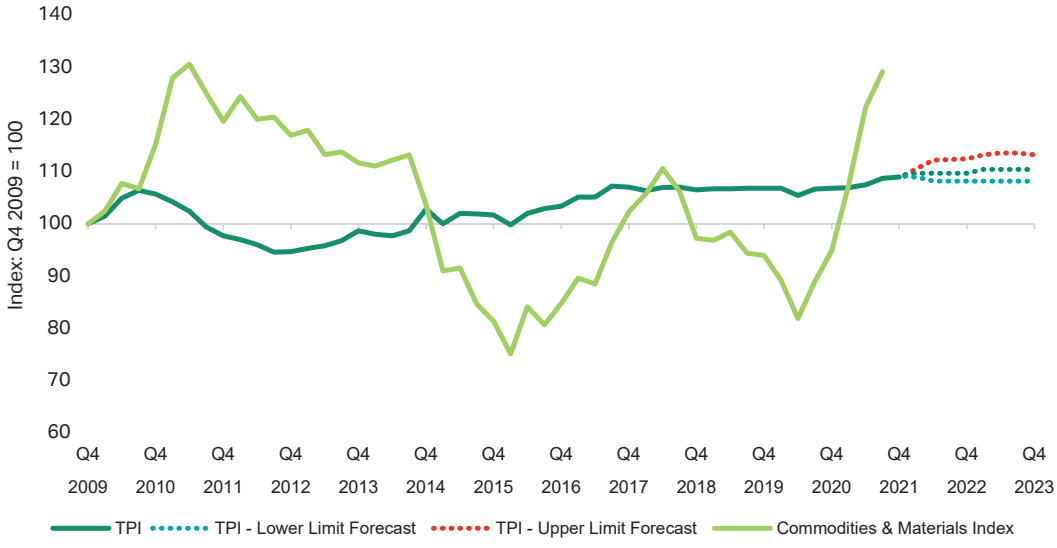
These rates should not be misinterpreted as contractors' day work rates.

UAE Tender Price Index

The UAE Tender Price Index (TPI) is AECOM's assessment of construction tender prices in the UAE. It is compiled by AECOM's Middle East Business Intelligence team and is based on actual returns of projects.

The Index is a measure of average price increases across differing project types and locations across the UAE. It should be regarded as a guide only when looking at any specific project, as the pricing of individual projects will vary depending on factors such as their complexity, location, timescale, etc.

AECOM UAE Tender Price Index



UAE tender price indices

Annual percentage change (average)												
2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
-17.08	2.37	-3.54	-5.30	1.12	2.74	2.11	0.62	4.02	0.56	0.04	-0.39	1.45

Source: AECOM, IMF

AECOM's UAE TPI was anticipating a y-o-y change from 2020-2021 of between 1.0 - 1.5 per cent. This slight upward growth considers that although the market is experiencing considerable commodity price hikes and pricing pressures, this is being offset by prudent business costs revisions implemented following the mitigations of the coronavirus pandemic.

Generally, construction organizations are operating at lower margins and have been seen to be hedging that markets will subside once pandemic economic restrictions ease.

Overall increased competitiveness has driven prices to remain subdued, and rate increases are typically sluggish to be reflected in tender returns, as tenderers look to keep historic norms in a bid to be more competitive.

As the pandemic restrictions continue globally, tender prices are increasingly under pressure to adjust upwards and is expected to become more prevalent in the first half of 2022. In consideration, AECOM forecasts that the UAE TPI will increase to 1.5 - 3.5 per cent in 2022, as pandemic induced prices hikes continue to be sustained.

MENA exchange rate comparison

	Euro zone	UK	India	China	Japan	UAE	KSA	Qatar	Oman	Bahrain	Kuwait	Egypt	Lebanon	Jordan
1 USD =	EUR	GBP	INR	RMB	JPY	AED	SAR	QAR	OMR	BHD	KWD	EGP	LBP	JOD
H1 2012	0.77	0.63	52.1	6.3	79.7	3.67	3.75	3.64	0.38	0.376	0.278	6.0	1,490	0.707
H2 2012	0.79	0.63	54.6	6.3	79.8	3.67	3.75	3.64	0.38	0.376	0.281	6.1	1,483	0.707
H1 2013	0.76	0.65	55.0	6.2	95.5	3.67	3.75	3.64	0.38	0.376	0.284	6.9	1,486	0.707
H2 2013	0.75	0.63	62.0	6.1	99.6	3.67	3.75	3.64	0.38	0.376	0.283	6.9	1,489	0.707
H1 2014	0.73	0.60	60.8	6.2	102.4	3.67	3.75	3.64	0.38	0.376	0.282	7.0	1,489	0.707
H2 2014	0.78	0.62	61.2	6.2	109.2	3.67	3.75	3.64	0.38	0.376	0.287	7.2	1,492	0.707
H1 2015	0.90	0.66	62.8	6.2	120.3	3.67	3.75	3.64	0.38	0.376	0.299	7.5	1,491	0.707
H2 2015	0.91	0.65	65.4	6.3	121.8	3.67	3.75	3.64	0.38	0.376	0.302	7.8	1,488	0.707
H1 2016	0.90	0.70	67.2	6.5	112.8	3.67	3.75	3.64	0.38	0.376	0.302	8.4	1,508	0.709
H2 2016	0.91	0.78	67.2	6.7	105.9	3.67	3.75	3.64	0.38	0.376	0.303	11.6	1,508	0.709
H1 2017	0.92	0.79	65.7	6.9	112.4	3.67	3.75	3.64	0.38	0.376	0.305	18.0	1,508	0.709
H2 2017	0.85	0.76	64.5	6.6	111.9	3.67	3.75	3.64	0.38	0.376	0.302	17.8	1,508	0.709
H1 2018	0.83	0.73	65.7	6.4	108.7	3.67	3.75	3.64	0.38	0.376	0.301	17.7	1,508	0.709
H2 2018	0.87	0.77	70.7	6.8	111.9	3.67	3.75	3.64	0.38	0.376	0.303	17.9	1,508	0.709
H1 2019	0.88	0.77	70.1	6.8	110.4	3.67	3.75	3.64	0.38	0.376	0.304	17.4	1,508	0.709
H2 2020	0.89	0.75	73.2	6.5	103.0	3.67	3.75	3.64	0.38	0.38	0.300	15.7	1,508	0.710
H1 2021	0.86	0.74	74.3	6.5	112.0	3.67	3.75	3.64	0.38	0.38	0.300	15.7	1,508	0.710

Bank of England, www.fxtop.com

Masdar Central Park, Abu Dhabi, UAE

Weights and measures

Metric measures and equivalents

Length

1 millimeter (mm)	=	1 mm	=	0.0394 in
1 centimeter (cm)	=	10 mm	=	0.3937 in
1 meter (m)	=	100 cm	=	1.0936 yd
1 kilometer (km)	=	1000 m	=	0.6214 mile

Area

1 square centimeter (cm^2)	=	100 mm^2	=	0.1550 in^2
1 square meter (m^2)	=	10 000 cm^2	=	1.1960 yd^2
1 hectare (ha)	=	10 000 m^2	=	2.4711 acres
1 square kilometer (km^2)	=	100 ha	=	0.3861 $mile^2$

Capacity/volume

1 cubic centimeter (cm^3)	=	1 cm^3	=	0.0610 in^3
1 cubic decimeter (dm^3)	=	1000 cm^3	=	0.0353 ft^3
1 cubic metre (m^3)	=	1000 dm^3	=	1.3080 yd^3
1 liter (l)	=	1 dm^3	=	1.76 pt
1 hectolitre (hl)	=	100 litre	=	21.997 gal

Mass (weight)

1 milligram (mg)			=	0.0154 grain
1 gram (g)	=	1000 mg	=	0.0353 oz
1 kilogram (kg)	=	1000 g	=	2.2046 lb
1 tonne (t)	=	1000 kg	=	0.9842 ton

USA measures and equivalents

U.S. dry measure equivalents

1 pint	=	0.9689 UK pint	=	0.5506 liter

U.S. liquid measure equivalents

1 fluid ounce	=	1.0408 UK fl oz	=	29.574 ml
1 pint (16 fl oz)	=	0.8327 UK pt	=	0.4723 liter
1 gallon	=	0.8327 UK gal	=	3.7854 liter

Imperial measures and equivalents

Length

1 inch (in)			=	2.54 cm
1 foot (ft)	=	12 in	=	0.3048 m
1 yard (yd)	=	3 ft	=	0.9144 m
1 mile	=	1760 yd	=	1.6093 km
1 int. nautical mile	=	2025.4 yd	=	1.853 km

Area

1 square inch (in2)			=	6.4516 cm^2
1 square foot (ft2)	=	144 in^2	=	0.0929 m^2
1 square yard (yd2)	=	9 ft^2	=	0.8361 m^2
1 acre	=	4840 yd^2	=	4046.9 m^2
1 sq mile (mile2)	=	640 acres	=	2.59 km^2

Capacity/volume

1 cubic centimeter (cm^3)	=	1 cm^3	=	0.0610 in^3
1 cubic decimeter (dm^3)	=	1000 cm^3	=	0.0353 ft^3
1 cubic meter (m^3)	=	1000 dm^3	=	1.3080 yd^3
1 litre (l)	=	1 dm^3	=	1.76 pt
1 hectolitre (hl)	=	100 litre	=	21.997 gal

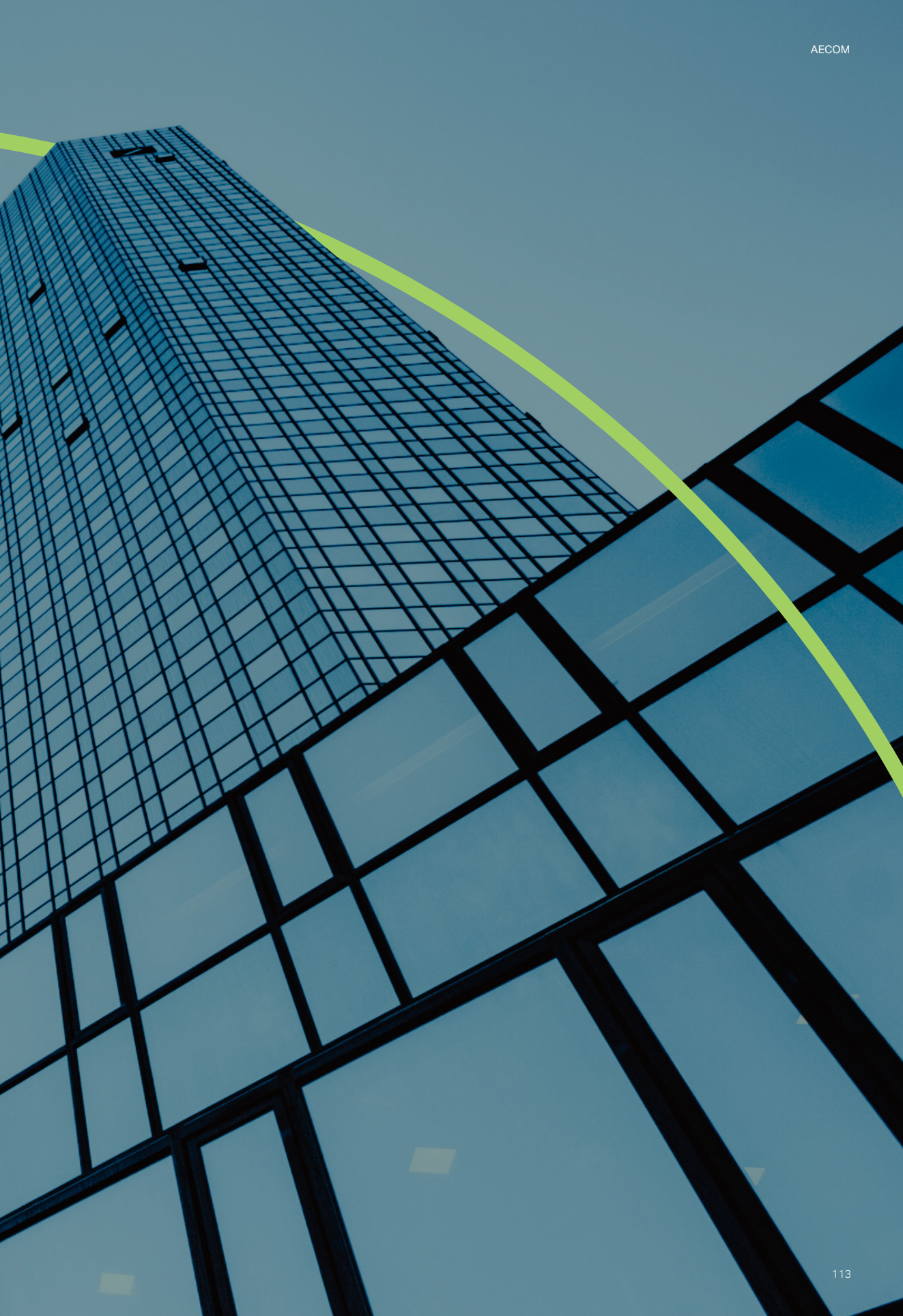
Mass (weight)

1 ounce (oz)	=	437.5 grains	=	28.35 g
1 pound (lb)	=	16 oz	=	0.4536 kg
1 stone	=	14 lb	=	6.3503 kg
1 hundredweight (cwt)	=	112 lb	=	50.802 kg
1 ton	=	20 cwt	=	1.016 tonne

Temperature conversion

C = 5/9 (F – 32) F = (9/5 C) + 32

05 Office directory



Office directory

United Arab Emirates

Abu Dhabi
(Regional Head Office)
International Tower
Capital Center
Level 10
PO Box 53
Abu Dhabi

T: 971 2 613 4000
F: 971 2 613 4001
abudhabi@aecom.com

Al Ain
Liwa Center Building
Level 1
PO Box 1419
Al Ain

T: 971 3 702 6600
F: 971 3 755 4727
alain@aecom.com

Dubai
U-Bora Tower
Level 43
PO Box 51028
Business Bay, Dubai

T: 971 4 439 1000
F: 971 4 439 1001
dubai@aecom.com

Kingdom of Saudi Arabia

Al Khobar
(Saudi Arabia Head Office)
AECOM Arabia Ltd
2nd Floor, Zamil House
Prince Turki Street
PO Box 1272,
Saudi Arabia
Al Khobar 31952

T: 966 12 849 4400
F: 966 13 849 4411
alkhobar@aecom.com

Riyadh
Tawuniya Towers,
South Tower, Mezzanine Floor,
King Fahad Road
PO Box 58729
Riyadh 11414,
Saudi Arabia

T: 966 11 218 0099
F: 966 11 218 0098

Jeddah
5th Floor, Al Murjan Tower
Prince Sultan Street
PO Box 23431
Jeddah
Saudi Arabia

T: 966 12 6069170
F: 966 12 6069205
jeddah@aecom.com

Kingdom of Bahrain

Manama
United Tower, 32nd Floor
Building 316, Road 4609
Block 346, Manama/Sea front
PO Box 640, Manama

T: 973 17 588 796
F: 973 17 581 288
bahrain@aecom.com

Qatar

Jaidah Square
4th Floor, Jaidah Square
Umm Ghuwalina
Al Matar Street
PO Box 6650
Doha

T: 974 4 407 9000
F: 974 4 437 6782
qatardc.middleeast@aecom.com

Oman

Muscat
Unit No.38, 3rd Floor,
Al Noor Building No. H17,
Plot No 15, Block No. 205,
Street No. 56
Al Qurum, Muscat
PO Box 434

T: 968 2 495 8800
F: 968 2 495 8801
muscat.aecom@aecom.com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