

State of Play for Circular Built Environment in Gulf Cooperation Council

Countries considered: Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and UAE

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One Planet Network

The One Planet network has been formed to implement the 10-Year Framework of Programmes on Sustainable Consumption and Production (SCP), which supports the global shift to SCP and the achievement of SDG 12. The One Planet Network acts as an enabler bringing actors from all regions to pool their expertise, resources, innovation and commitment towards a shift to more sustainable modes of production and consumption. The network comprises of six programmes: Sustainable Public Procurement, Sustainable Buildings and Construction, Sustainable Tourism, Sustainable Food Systems Programme, Consumer Information for SCP, Sustainable Lifestyles and Education.

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The Sustainable Buildings and Construction Programme (SBC) aims at improving the knowledge of sustainable construction and to support and mainstream sustainable building solutions. Through the programme, all major sustainable construction activities can be brought together under the same umbrella. The work involves sharing good practices, launching implementation projects, creating cooperation networks and committing actors around the world to sustainable construction. The goal of the programme is to promote resource efficiency, mitigation and adaptation efforts, and the shift to SCP patterns in the buildings and construction sector.

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The Sustainable Buildings and Construction Programme has been preparing regional reports on the state of play for circular built environment in Africa, Asia, Europe, Gulf Cooperation Council countries, Latin America and the Caribbean, North America, and Oceania. In addition to regional outlooks, a global report has been produced to summarise and compare the state of play regarding circularity in different regions. A crucial role of the reports is not only to provide a benchmark but also recommendations on how to move forward towards a sustainable and circular built environment.

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List of acronyms

DEWA	Dubai Electricity and Water Authority
EMF	Ellen McArthur Foundation
GCC	Gulf Cooperation Council
GDP	Gross domestic product
GORD	Gulf Organisation for Research and Development
GPCA	Gulf Petrochemicals and Chemicals Association
GSAS	Global Sustainability Assessment System
NEEAP	National Energy Efficiency Action Plan
NREAP	National Renewable Energy Action Plan
RAK	Ras Al Khaimah
UAE	United Arab Emirates
UNEP	United Nations Environment Programme

Executive summary

The Gulf Cooperation Council (GCC) countries are among the fastest developing in the world. However, their economies are currently largely based on a linear model which follows a 'take, make, dispose' approach. In addition, the region's resources consumption rates are among the highest globally. This places a strain on finite natural resources and increases the demand for energy.

There are many drivers for the region to move towards a holistic approach to circular economy. As of 2018, the GCC population reached 56 million people, with further expected growth in the coming years, and a huge portion of the population already living in cities. Current consumption patterns in the region are unsustainable, on both a domestic and business level. The average global ecological footprint is 1.7 global hectares, approximately five times less than the lowest ecological footprint in the GCC (Global Footprint Network, 2016). Since the construction sector in the GCC is one of the most fast-paced and highest-growth sectors, it could be a key player for the region in relation to the adoption of circular economy principles.

The circular economy model set by the Ellen MacArthur Foundation is based on three basic principles: designing out waste and pollution, keeping products and materials in use, and regenerating natural systems (Acharya, Boyd, and Finch, 2018). This report provides an overview of the current state of business model utilised in GCC countries and highlights opportunities for intervention.

GCC countries are at various stages of exploring more sustainable policies and practices to ensure a better future for their citizens and residents. Policies and incentives are being developed to encourage green economies, resource efficiency and renewable energy strategies across the region. While efficient waste management, designing energy-efficient buildings and minimising the environmental impacts of the construction sector are already in consideration, a game changer in the sector would be introducing alternative practices including the following:

- Design future-proof buildings.
- Prioritise retrofitting/ refurbishment rather than demolition.
- Embrace new business models, from adaptable assets to enhancing residual spaces.
- Develop policies and strategies for mobility and transportation.
- Ensure recycling procedures maintain the material value.
- Implement performance procurement and product as service.
- Execute renewable energy initiatives.
- Expand waste-to-energy strategies.

The GCC countries need to establish a common ground between stakeholders and policy-makers from project inception to operation. The 'business as usual' approach will need to be reconsidered, driving the need for new jobs and skills and fostering opportunities for more collaboration across sectors such as public-private partnerships.

1. Introduction

The world today is on the cusp of the fourth industrial revolution yet, even after evolution and diversification, the way the industrial economy works has not fundamentally changed in decades. It is still largely based on a linear model of production that follows a 'take, make, dispose' approach, placing a strain on finite resources and producing large amounts of waste (Ellen McArthur Foundation [EMF], 2013).

In addition, there are several other weaknesses and lost opportunities related to this model:

1. Resource extraction becomes harder with time.
2. Material use during the production process is not optimised.
3. Product life is not maximised.
4. Waste from the production and post-consumption phases is not reused.
5. Price volatility remains high.
6. Environmental costs rise due to the increase in resource depletion.

While the linear approach may have been viable in the past, albeit with significant negative environmental impacts, it will not continue to be viable in the future due to the rapidly growing global population and diminishing resources. This has led to the development of the concept of 'circular economy', also known as 'the closed-loop economy'. Circular economy is defined as an approach where nothing goes to waste, by extending the lifespan and economic value of resources and sustaining growth by turning used resources into new income streams (Acharya, Boyd, and Finch, 2018).

Circular economy, therefore, is more than just recycling and waste reduction. It is an economic model that spans supply chains and sectors, and redefines the process of product design, manufacturing and consumption, thus opening up new, unexploited markets for companies. It is a model that 'builds economic, natural, and social capital' (Acharya, Boyd, and Finch, 2018).

The circular economy model is based on the following three basic principles (Acharya, Boyd, and Finch, 2018):

- a. **Design out waste and pollution** – minimising the waste produced in construction and deconstruction processes to reduce the negative impact of economic activity on natural systems with the objective of ensuring that equipment and components are recyclable at the end of their service lives.
- b. **Keep products and materials in use** – maximising the life expectancy of materials through refurbishment and recycling of materials and components.
- c. **Regenerate natural systems** – protecting natural resources to create a more resilient ecosystem.

The built environment is defined as human-made surroundings that provide the setting for human activity, ranging in scale from buildings and parks to neighbourhoods, transportation systems, and entire cities (Kitahara et al., 2018). A circular built environment embeds the three guiding principles of circular economy by maintaining a closed-loop approach such that no materials go to waste; instead, products are reused or repurposed.

1.1 Aim

The aim of this report is to provide a snapshot of the current practices related to the adoption of circular economy principles in the built environment in GCC countries (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the UAE), with a focus on the United Arab Emirates (UAE).

By exploring opportunities for circular economy in the built environment, this report also seeks to encourage the adoption of new approaches and methods in that construction sector that support a closed-loop model whereby no materials or assets go to waste, and products and places are instead reused or repurposed.

1.2 Methodology

This report has been developed based on the following methodology:

1. Desktop review of current built environment practices and policies in the GCC from a circular economy perspective. Information was collected from publicly available sources including academic and non-academic research papers, national and local government statistics, newspaper articles, and regional and international reports (section 2).
2. Identification of opportunities that can help transform the current state of circular economy in the GCC. This section looks at previous work carried out by Arup on circular economy and case studies with relevance in the region (section 3).
3. Summary of recommendations with a focus on regional opportunities (section 4).

2. State of play: drivers for circular economy in the GCC

2.1 Context

Circular economy is a relatively new concept in GCC countries, as evidenced by the limited information found on the topic across these countries. The following subsections describe the current situation in the GCC in relation to circular economy.

2.1.1 Population growth

The total population of GCC countries in 2017–18 was approximately 56 million, which is 0.07% of the global population. Population growth is heavily driven by immigration, with expatriates making up 51.9% of the region's population (Gulf Labour Markets and Immigration, 2018).

2.1.2 Urbanisation and urban sprawl

The GCC is one of the most highly urbanised parts of the world, with 85% of the population living in cities today, and this is expected to rise to 90% by 2050 (PwC, 2020).

The region continues to oversee megadevelopments in cities. The value of new developments and projects in construction is expected to increase to USD350–400 billion by 2023 (Bejjani et al., 2019). This puts the GCC in a strategic position to implement circular strategies in construction and planning to minimise the impact of increased construction in the region and utilise existing land to better retrofit cities for a sustainable future (Bejjani et al., 2019).

2.1.3 Economy

2.1.3.1 Diversification

Although the oil and gas sector to date remains the largest contributor to the region's GDP, GCC countries are constantly looking to diversify the economy to improve the resilience of the region. In recent decades, these countries have invested in and developed sectors such as tourism, logistics, transportation and financial services. For example, the Government of Bahrain has invested in becoming an offshore financial sector, while the UAE Government has supported a hub for international travel and logistics. Saudi Arabia is establishing industrial and economic zones to promote technology, industrial and service clusters around oil and mining. Meanwhile, Kuwait is developing downstream oil industries and Qatar has established industrial cities that house a mix of energy-related industries to help integrate upstream and downstream hydrocarbon activity (Callen et al., 2014).

As an example of diversification, according to the UAE Annual Economic Report 2019 (UAE Ministry of Economy, 2019), non-oil sectors accounted for 70% of GDP, with the oil sector contributing the remaining 30%. Within the non-oil sector, 'wholesale, retail, and vehicle repair' accounted for 11.6% of GDP, while 'construction and building' accounted for 8.5%. Similarly, 'manufacturing' comprises 8.5% of GDP, with a large portion dedicated to steel and aluminium production for the built environment, illustrating the level of economic diversification in the UAE and the effect on GDP (UAE Ministry of Economy, 2019).

2.1.3.2 Built environment sectors

Over the past decade, the construction and transport sectors in GCC countries have been some of the most active sectors and sources of employment. Nevertheless, all GCC countries except the UAE saw a 50% decline in acquisitions of new contracts in these sectors between 2014 and 2018 (Deloitte, 2018).

The breakdown by economic sector, as registered in the Ministry of Human Resources and Emiratization in the UAE, indicates that building and construction comprises about 65,000 of 338,000, or almost 20%, of all registered entities, making it the second-highest sector in terms of number of entities after trade and repair services (UAE Ministry of Economy, 2019). This breakdown emphasises further the significance of the built environment and construction in the economy.

2.1.3.3 Green jobs

With the aim of safeguarding the economy for a post-oil era, the GCC countries are developing strategies and policies towards green economy and renewable energy.

It is expected that, by 2030, 135,000 new jobs will be created every year in new job sectors generated as a response to renewable strategies, with a high percentage concentrated in the UAE and Saudi Arabia (El-Katiri et al., 2019). It is envisaged that the waste-to-energy sector might contribute to around 6% of the jobs generated, without accounting for the operational jobs in waste collection and processing (El-Katiri et al., 2019).

2.1.4 Public awareness

In 2009, the Gulf Petrochemicals and Chemicals Association (GPCA) commissioned a survey on the perception of plastics across the six GCC countries. The aim of the survey was to provide a clear and up to date picture of the public's view on recycling and gauge their opinion on what they see as a solution going forward (GPCA, 2017).

The study revealed that only 38% of GCC residents had an informed view of recyclable and degradable plastics. Moreover, the study emphasised the importance of 'building a sustainable and profitable plastics recycling industry that transforms the current economic model from linear to circular' to support a sustainable waste management process throughout the GCC (GPCA, 2017).

2.2 Resource consumption

2.2.1 Consumption patterns

Current consumption practices in the region are largely unsustainable. In 2016, the Global Footprint Network ranked Qatar with the highest ecological footprint, at 14.4 ha/person, followed by the UAE in third place at 8.9 ha/person, Bahrain in fourth place at 8.6 ha/person, and Kuwait in fifth place at 8.6 ha/person. The average global ecological footprint is 1.7 global hectares, approximately five times lower than the lowest ecological footprint in the GCC (Global Footprint Network, 2016). Furthermore, there is an increasing domestic and agricultural demand on the region's limited groundwater resources. Saudi Arabia and Kuwait consume over 300 litres per capita per day, and are therefore ranked among the highest water consumers in the world. All six GCC countries feature in the World Resource Institute's list of countries that are expected to be 'extremely highly stressed' in terms of access to water by 2040 (Bejjani et al., 2019).

2.2.2 Energy consumption

GCC countries have some of the highest energy consumption per capita rates in the world (Azar and Abdel Raouf, 2018). The high energy consumption is partly a result of energy-intensive industries such as steel and aluminium manufacturing, and the energy-intensive water supply processes including desalination. The industrial sector accounts for about 47% of energy consumption in the GCC, followed by transport and residential use (El-Katiri et al., 2019).

2.2.3 Renewable energy

2.2.3.1 Renewable energy targets

In the GCC region, only 1% of the 146 GW of installed power capacity is considered renewable energy (El-Katiri et al., 2019). However, there is an aim to focus more on renewable energy moving forward. There are two major factors pushing the GCC to opt for renewable energy strategies; the high demand on grid electricity as the population continues to grow and the demand on groundwater desalination due to high consumption rates, which are putting strain on the region's natural resources and generating high costs to enable supply to keep up with demand. Other factors pushing the GCC towards renewable energy are the rising costs of utilising oil and gas to generate power and the decreasing production costs in the renewable energy market.

Between 2006 and 2018, the GCC committed around USD10.1 billion towards renewable energy investment (Ollero and Hussain, 2019). Based on the sustainable energy targets set by the GCC region, the UAE accounts for 68% of the renewable energy capacity, followed by Saudi Arabia at 16% and Kuwait at 9% (El-Katiri et al., 2019). Investment in renewable energy projects has seen an increase over the past 14 years, with the UAE taking the lead (Ollero and Hussain, 2019).

2.2.4 Waste management and consumption

Waste management is a key challenge for all the GCC countries. A recent study outlined the accelerating rate at which waste is generated due to extravagant lifestyles, the absence of strict policies and regulations, and the lack of public awareness (Zafar, 2018).

There is growing concern in the region around domestic waste. In the UAE, the average resident produces approximately 1.8 to 2.4 kilograms of waste per day, which is about three times higher than the global average (Goblon, 2017). Waste is predominantly disposed of in landfills, contributing to economic inefficiency and negative environmental impacts.

2.2.4.1 Construction waste

The GCC construction sector accounts for 35–40% of all solid waste produced in the region, with the majority ending up in landfill (Bejjani et al., 2019). According to Abu Dhabi 2018 Statistics, construction and demolition waste accounted for 32% (Statistics Centre Abu Dhabi, 2018). The percentages vary between countries and emirates.

2.2.4.2 Land availability

As mentioned above, currently the most prevalent method of waste management is landfill disposal. In most cases these landfills are not engineered or properly managed and therefore pose an environmental risk and a health hazard. An additional factor related to the issue of waste management in the GCC is the limited availability of land in countries such as Qatar, Kuwait and Bahrain, limiting the long-term viability of landfilling as an option for waste management (Zafar, 2018).

For example, Kuwait is a relatively small country but has a high number of landfills, 14 out of 18 of which have been closed due to improper management and their proximity to residential areas. Having such a large area occupied by landfills is a threat to public health, as the distance between communities and landfill sites diminishes (Zafar, 2018). Various problems have emerged from the improper management of landfill sites, such as groundwater contamination, spontaneous fires and the spread of toxic gases. A frequent problem in Kuwait is the 'migration of leachate' beyond the landfills into other areas of the city, posing an environmental hazard and a health hazard for the citizens (Zafar, 2018).

2.3 Policies and incentives

2.3.1 Policies

GCC countries are at various stages of exploring more sustainable policies and practices to ensure a better future for their citizens and residents. This includes developing policies and incentives related to green economies, resource efficiency and renewable energy.

Table 1 summarises the aims set out in the national vision documents of GCC countries, with an emphasis on sustainable development (Azar and Abdel Raouf, 2018).

Table 1: GCC initiatives towards sustainable economy

Source: Adapted from Azar and Abdel Raouf, 2018

Graphics: Ninni Westerholm

Country	Vision and strategies	Aims and objectives
UAE	UAE Vision 2021 Green Economy Abu Dhabi Vision 2030	The policies and strategies aim to introduce various sustainable strategies both on an economic and resource level to build resilience in the UAE and promote economic diversification.
Qatar	Qatar National Vision 2030	Qatar's vision is split into four main categories to help the country achieve a sustainable development by 2030: Economic, social, human and environmental development.
Oman	Oman's Vision 2040	The vision aims to develop a sustainable economy in Oman, shifting away from an oil focus into other sectors like tourism and other services.
Bahrain	The Economic Vision	The vision provides a holistic approach to develop Bahrain in the right direction and improve the life of Bahrainis.
Saudi Arabia	Saudi Vision 2030	The Saudi vision has a strong focus on shifting away from an oil-based economy and instead build on a more sustainable economy.
Kuwait	Kuwait's Vision: The year 2030	The Kuwait vision aims to develop and create a sustainable economy in the country.

In addition to the above initiatives, Dubai Plan 2021 encompasses a holistic and complementary perspective on the future of Dubai, starting with the people and society (Government of Dubai, 2019). The plan addresses the urban environment including both natural and built assets and looks at the living experience of the people of Dubai and its visitors as a result of their interaction with this environment and the economic and social services provided. In addition, the plan also focuses on the economy, which is the city's development engine, fuelling its march forward.

Below are some examples of policies in the GCC region, discussed according to each of the three principles of circular economy explored in this report (Acharya, Boyd and Finch, 2018).

A) Designing out waste and pollution

Among the GCC countries, the UAE has the most ambitious plans. The UAE Vision 2021 includes targets on the treatment of waste, the development of renewable energy and water recycling, supporting a transition towards a more circular economy. Similarly, Saudi Arabia's Vision 2030 seeks to safeguard the environment by increasing the efficiency of waste management, establishing comprehensive recycling projects, and reducing all types of pollution (Al-Sadoun, 2018).

There are a few policies and regulations implemented in the region regarding energy-efficient buildings which are aimed at reducing energy costs and pollution. In the UAE, Ras Al Khaimah (RAK) Municipality recently launched a green building regulations guide titled 'Barjeel'. These regulations are first being launched on a voluntary basis, to ease the transition towards green building as it gradually rolls out across the entire emirate (Mechanical Electrical Plumbing ME, 2019). This aligns with the RAK Efficiency and Renewable Energy Strategy 2040, which aims for a 30% energy saving, a 20% water saving and a 20% share of energy to come from renewable energy (Mechanical Electrical Plumbing ME, 2019).

Furthermore, Abu Dhabi and Dubai have introduced various waste management policies. In Abu Dhabi, Tadweer, a government-established Centre of Waste Management in the UAE (Tadweer, 2020), introduced a waste classification policy with the following objectives: to ensure that waste is treated and handled correctly; to divert waste from landfills to promote reuse, recycling and recovery; and to impose tariffs to encourage reuse, recycling and recovery (Environmental Agency Abu Dhabi, 2016). In addition, as part of the National Agenda 2021, the UAE is working towards achieving an integrated waste management plan by developing relevant policy and legislation. In 2018, the UAE passed the federal law no. 12 for the Integrated Waste Management Plan 2018, which aims to 'regulate waste management among UAE emirates and unify the mechanisms of sound disposal' (UAE Ministry of Climate Change and Environment, n.d.).

Similarly, in Oman, in 2009, a Royal Decree No. 46/2009 granted Bee'ah (Oman Environmental Service Holding Company) the legal status to be responsible for solid waste management in the country, with the aim of creating a more sustainable waste management practice and establishing the required infrastructure and collection points and promoting public awareness across the country (Bee'ah, 2017).

B) Keeping products and materials in use

Few policies have been developed in the region that are explicitly designed to ensure a closed-loop cycle of materials or products reuse. However, it is expected that more policies regarding material use will emerge to facilitate the achievement of the national visions and strategies referenced above.

In the UAE, Abu Dhabi introduced a policy on single-use plastic in March 2020, which aims to eliminate single-use plastic in the emirate by 2021. The policy has three goals: a short-term goal focused on single-use plastic items and finding sustainable alternatives, a medium-term goal focused on establishing a closed-loop circular system to recycle plastic, and a long-term goal focused on fostering and embedding a culture of reuse and recycling throughout society (Environmental Agency Abu Dhabi, 2020).

Moreover, in the UAE, Bee'ah – a public-private partnership environmental body established in Sharjah – has taken the lead in the reuse and recycling of materials for the construction of roads and cycle tracks. Similarly, in Ras Al Khaimah, the Environment Protection and Development Authority launched a plastic free initiative to replace single-use plastic bags with an environmentally friendly alternative, with the aim of expanding to more sectors in Ras Al Khaimah in 2021 (Environment Protection & Development Authority, 2020). Bee'ah is currently making progress towards enabling Sharjah to become one of the first zero-waste-to-landfill cities in the GCC region and Middle East and simultaneously changing public attitudes towards waste consumption and by the adoption of cutting-edge waste-to-energy conversion facilities (Bee'ah, 2017).

In 2017, a regulation was introduced in Saudi Arabia to stop the import of non-biodegradable plastic and to only allow the use of oxo-biodegradable plastic. This regulation covers disposable plastic bags such as shopping bags, garbage bags, garment bags and woven barley bags as well as disposable tableware (Möhr, 2019).

As of 2019, Bahrain had issued a ministerial order number to reduce, and eventually ban, the use of plastic bags across the Kingdom, with the aim of also banning the import of plastic bags for use in specific supermarkets and malls (United Nations Environment Programme [UNEP], 2019). The Supreme Council of Environment is working with the Ministry of Industry, Commerce and Tourism on policies and regulations to ensure the adoption of a sustainable alternative to current practices (UNEP, 2019).

C) Regenerating natural systems

The region’s driving forces towards renewable energy include the need to: protect fossil fuel reserves, minimise dependence on power generation from oil and gas, protect natural capital assets and increase economic and environmental resilience. Table 2 summarises the various policies implemented by the six GCC countries to promote the use of renewable energy (El-Katiri et al., 2019).

Table 2: Renewable energy policies across GCC countries

Source: El-Katiri et al., 2019

Graphics: Ninni Westerholm

Country	Renewable energy policies	Aims and objectives
UAE	UAE Vision 2021 UAE Green Growth Strategy UAE Future Strategy UAE Centennial Plan (2071)	The focus of these policies is on knowledge creation and technology innovation. The UAE energy strategy aims to increase the share of clean energy to 50% by 2050.
Qatar	Qatar’s Second National Development Strategy 2018–2022	This strategy sets out a plan for natural resource management that calls for an increase in renewable energy use.
Oman	National Energy Strategy to 2040 Oman’s Vision 2040	One of the goals is a green and circular economy that is responsive to national needs and consistent with the global direction of adapting to climate change.
Bahrain	National Renewable Energy Action Plan (NREAP) National Energy Efficiency Action Plan (NEEAP)	The NREAP sets a national renewable energy target of 5% by 2025 and 10% by 2035. The NEEAP sets a national energy efficiency target of 6% by 2025.
Saudi Arabia	National Renewable Energy Programme Vision 2030	The National Renewable Energy Programme aims for 10% power generation capacity from renewable energy by 2023 and 70% power generation by 2030. Vision 2030 aims to diversify the economy, making it less dependent on oil.
Kuwait	Kuwait’s Vision 2035	One of the vision’s pillars is the country’s commitment to building a sustainable living environment.

2.3.2 Incentives and initiatives

It is expected that construction and development activities and associated waste production will continue to rise in the GCC region. Incentives are usually a good mechanism for encouraging waste and pollution reduction. Some of the current incentives adopted within the GCC countries are outlined below, categorised according to the three circular economy principles discussed in this report.

A) Designing out waste and pollution

To reduce the environmental impacts and improve the socio-cultural and economic performance of buildings, various sustainability rating systems and green building regulations are enforced throughout the UAE. These rating systems and regulations requirements for construction and demolition waste management with the aim of facilitating waste reduction during construction and preventing the depletion of material resources (Swain, 2018). Some examples include:

- The Al Sa'fat Green Building Rating System in Dubai – This system sets a mandatory requirement for all new buildings to obtain a permit. The Al Sa'fat rating system aims to reduce waste by 50%, reduce carbon emissions by 20%, reduce electricity consumption by 20% and reduce water consumption by 15% (Saseendran, 2016).
- The Trakhees Environmental, Health and Safety Department's rating system for Dubai – Trakhees is an authority with jurisdiction in Dubai. This system aims to reward projects that divert 50–75% of all construction and demolition waste materials from landfill.
- The Estidama rating system in Abu Dhabi – This system is intended to divert a minimum of 30% of construction and demolition waste through recycling/salvaging. The aim is to encourage the reuse of existing building stock, and to reduce waste and associated environmental impacts (Swain, 2018).

Saudi Arabia has established a green building rating system known as Mostadama, which is tailored to the country's need to promote sustainable construction standards. This rating system was developed by the Ministry of Housing specifically for the Saudi market (Younis, 2020).

The Global Sustainability Assessment System (GSAS) is the first performance-based rating system for green buildings and infrastructure in the Middle East and North Africa (Gulf Organisation for Research and Development [GORD], 2019). It is currently the only rating system certified by the Qatar Construction specifications (SmrtE, n.d.).

Other initiatives introduced by GCC countries to improve waste management in the region include:

- The Domestic Solid Waste Management Centre at Mesaieed Doha, which aims to maximise energy yields from resources through waste separation, pre-processing, recycling and waste-to-energy processes (Zafar, 2018).
- Al Amerat Landfill in Oman, which aims to process solid waste via an environmentally friendly method. This project is one of the government's initiatives to establish more engineered landfills, waste transfer stations and waste treatment plants across the country (Zafar, 2018).
- The Natural Waste Management Strategy in Saudi Arabia, which aims to improve the management of the country's municipal waste and generate business opportunities by establishing material recovery and waste-to-energy facilities (Zafar, 2018).

- Bee'ah in the UAE, which aims to provide waste management solutions to tackle the problem of the growing number of landfill sites in the country, by setting up facilities to recycle material and divert around 70% of all waste away from landfill (Bee'ah Tadweer, 2020).
- The Retrofitting Guideline Manual, which has been developed by the Emirates Green Building Council along with training sessions for professionals in the built environment sector (EGBC, 2015).

B) Keep products and materials in use

In the UAE, Abu Dhabi recently launched a pilot project to adopt a closed-loop recycling model for plastic bottles, beverage cartons and other packaging. Several leading companies in the plastic industry are to contribute to this project, including BASF, Borouge, Tetra Park, Carrefour, Coca-Cola, Dow Chemicals, Environment Agency Abu Dhabi, the GPCA, McDonald's UAE, Nestlé, Procter & Gamble, PepsiCo, Unilever and Emirates Nature – WWF (Arabian Industry, 2019).

The Bee'ah waste management centre in Sharjah, UAE, invests heavily in waste sorting, processing, treatment and recycling facilities, to maximise efficiency in the use of resources and to attain sustainability goals (Bee'ah Tadweer, 2020). The aim is to process waste in such a way that products can be recycled, recovered, regenerated and put back into the economy, to support a sustainable and environmentally friendly cycle.

Hands Industries in Sharjah is a 20-year-old business that recycles second-hand textiles. The business manages thousands of tonnes of clothing at a sorting facility to be mended, cut and sewn to look good as new, and then exports the new clothing to people in need in Africa (Clarke, 2019).

C) Regenerate natural systems

As the demand on water and electricity increases in the GCC, the demand on natural resources like oil and gas to generate energy is putting the region's natural resources at risk. A shift towards a more diversified economy is key. Hence, utilising different forms of renewable energy sources is crucial to enabling a sustainable economy in the GCC.

In the UAE, the Shams Dubai has recently launched a program to encourage households to install solar energy panels in their homes and connect them to the Dubai Electricity & Water Authority (Dubai Electricity and Water Authority, n.d). Similarly, Saudi Arabia has completed Waad Al-Shammal solar plant and Kuwait is also taking the lead in increasing wind capacity generation with the completion of the Shagaya wind and solar plant (El-Katiri et al., 2019).

The Dubai Carbon Centre of Excellence is partnering with a New Zealand government-owned firm to measure and assess carbon emissions in both the public and private sectors in Dubai to obtain an accurate overview of the percentage of greenhouse gases in the air. This pilot project is set to align with the Dubai Clean Energy Strategy to reduce carbon emissions in Dubai by 16% by 2021 and increase the use of clean energy (Dubai Carbon, n.d.).

While the GCC region is at risk of water scarcity, very minimal effort is being put into establishing wastewater management plans and water recycling. There is no defined holistic approach.

3. Opportunities for the adoption of a circular economy model

This section outlines some of the opportunities available for the implementation of circular economy in the GCC region based on the three guiding principles (Acharya, Boyd, and Finch, 2018).

3.1 Design out waste and pollution

- a. **Design future-proof buildings.** There is an opportunity for all new construction to ensure that the potential future uses for each building are identified upfront (Poplewell, Marino and Boyd, 2020). In turn, this 'future-proof the building by clearly defining the brief and allowing the building to change. As the building can be adapted to suit the needs of the operator, the risk of demolition due to early obsolescence is mitigated, ensuring the highest likelihood that materials can be retained, and their lives extended' (Poplewell, Marino and Boyd, 2020). Involving the client at an early stage is important to optimise the best future uses of the building through collaboration with the owners and operators (Poplewell, Marino and Boyd, 2020).
- b. **Prioritise retrofitting/refurbishment rather than demolition.** Retrofitting involves the addition of new materials and/or technologies to improve the performance and value of the property. For instance, improving insulation makes a building more energy-efficient and therefore more sustainable, designing out pollution. Energy-efficient retrofitting is also a rapidly growing market because of the savings that can be made, and it is a far more affordable strategy in the short term than demolishing and rebuilding properties.

Blockchain technology

A report published by Arup on 'blockchain technology' considers the many ways blockchain can be merged with circular economy and BIM technology. It outlines how live BIM models can be 'digitally linked to their physical counterparts', thereby tracking the materials information throughout the construction stage, usage stage and reuse state. BIM models therefore have the potential to act as the main database for circular economy in building and construction, enabling users to oversee how buildings are managed and operated (Kinnaird and Geipel, 2017).

- c. **Embrace new business models in real estate.** In a recent publication by Arup and the EMF, five business models were identified to encourage circular economy in real estate (Acharya, Boyd and Finch, 2020):
 - Adaptable assets – Flexible building skin and structure that can be given to short-term investors to adapt to their needs. For example, a building's façade can be flexible to allow components to be retrofitted/changed as needed (Acharya, Boyd, and Finch, 2020).
 - Relocatable buildings – Designing modular spaces with high-quality materials for short-term usage. When the space is no longer in use or no longer needed, it can be easily deconstructed and moved to another site. This model 'designs out' waste by opting for prefabricated and modular construction techniques as opposed to traditional construction methods (Acharya, Boyd and Finch, 2020).
 - Flexible spaces – Sharing of underutilised spaces with other tenants. In some cases, buildings are not operating at full capacity, with less than 50% occupancy. Allowing flexible spaces to be shared will reduce the need for new buildings and construction, as available buildings can be utilised instead (Acharya, Boyd and Finch, 2020).

- Performance procurement – Extending the product-as-a-service model, currently seen in individual products such as lighting, to a higher level in the construction sector. Under product-as-a-service procurement, rather than buying products from suppliers through capital budgets, construction clients and tenants buy subscriptions for services provided by those products through operational budgets.
- Residual value – Creating a new type of contract like the futures contract. A price estimate for the recoverable materials used in the building is agreed on in the contract. The future contract can then be bought at any given time by interested parties, and they become the owners of the material. The main incentive provided by this contract is that it maintains the true value of the building material, thus ensuring it is kept at its highest quality during use, and extending the material lifespan.

Reconsidering contract models

As a regional example, the UAE construction Industry Think Tank aims to define a standardised construction contract model for the UAE to improve the construction industry. One of the aims is to '[e]nsure full project life-cycle considerations, define healthy, safety & environment targets, and ensure collaboration between stakeholders' (Meed Mashreq Industry Insight, 2020).

- d. Develop policies and strategies regarding mobility and transportation of goods.** 'In a circular economy, where goods and materials will increasingly circulate locally, effective urban freight and logistics are key' (EMF, 2019). The development of urban freight strategies can play a major role in ensuring that transportation systems align with circular economy concepts by reducing noise, waste and pollution. Around 90% of a city's air pollution is caused by vehicle emissions and around 2–5% of the world's GDP is lost due to congestion of vehicles, taking in the lost time, fuel usage and the cost to businesses. An integrated urban planning would ensure effective mobility and logistics flow in a city. In addition, governments can introduce incentives for zero-emission vehicles to improve the quality of the urban environment through public procurement (EMF, 2019).

Mobility as a service

The mobility-as-a-service model has taken off in many countries across the GCC region, such as ride-hailing applications like Careem in the UAE and Saudi Arabia.' Other ride-hailing applications include Uber and Lyft, which provide a private transport service to people without the need to acquire new vehicles as existing vehicles can be utilised.

3.2 Keep products and materials in use

- a. Ensure recycling procedure maintains the material value.** When a material is recycled it usually assumes a lower value. But we might ask: what materials might take on a higher value after recycling? And could the recycling procedure increase the material's value, or at least retain the initial value? These are critical questions when considering material reuse. For example, these questions are relevant when we consider coated glass, which currently cannot be recycled as vision glass. With the current material recycling processes available, recycling used materials comes at a cost, as such materials are not designed for reuse. Another contributing factor is that investors are not willing to accept the initial higher costs associated with increasing the material value to ensure that it can be reused.

A recent report by Arup, *Rethinking the life cycle of architectural glass*, outlines the process of recycling glass and repurposing it for other uses. While glass is 100% recyclable, the viability of its usage depends on the intended purpose, that is, whether it is used for insulation, glazing

or some other purpose. The study looks at recycling float glass and utilising cullet glass (waste or low-quality glass rejected during the manufacturing process) in the manufacture of float glass. It is estimated that for every tonne of cullet glass used, approximately 1.2 tonnes of raw materials and 300 kW/h of energy will be saved, and 300 kg of CO₂ emissions will not be emitted (DeBrincat and Babic, 2019).

- b. Implement performance procurement and product-as-a-service for building and construction products.** Under the product-for-service approach or performance procurement, instead of buying products using the project's capital cost, a subscription service is purchased with funds from the operational budget. Building components are 'hired' or 'leased' and the supplier oversees their maintenance as the product will be used in another building after the 'lease' period is over (Acharya, Boyd, and Finch, 2020).

Product as a service

For example, Philips provides a product-as-a-service package that allows businesses to 'pay per lux', which means they pay a fee for lighting as a service instead of purchasing light bulbs. Philips is responsible for installation and maintenance for the period for which the service is used, and once the material is no longer needed, Philips has the right to retain its products to either recycle or reuse them (Bejjani et al., 2019).

Waste-to-energy strategies in the region

Across the region, the UAE has introduced multiple initiatives to generate energy from waste. Masdar (Abu Dhabi's leading renewable energy company) has partnered with Bee'ah to establish the UAE's waste-to-energy sector and help achieve the targets set out by the UAE Government's Vision 2021 strategy (UAE official portal, 2020). For example, in Abu Dhabi, a 100-MW facility is proposed by the National Energy Company PJSC (TAQA) and Abu Dhabi's Centre of Waste Management (Tadweer) to provide power to almost 20,000 households and reduce carbon dioxide emissions (UAE official portal, 2020).

Saudi Arabia has announced that it intends to build a new waste-to-energy recycling facility for construction waste in Riyadh. The facility will turn waste into building material for road and housing construction projects including a 35,000-home scheme. The aim is also to expand the facility to cover the recycling of all kinds of waste, such as fertilisers, paper, plastic and metals (Construction Week Online Middle East, 2019).

Qatar is setting up a new waste treatment facility in Mesaieed to convert waste into energy as part of an integrated domestic solid waste management centre plan (Construction Week Online Middle East, 2013). Under this plan, the aim is to increase waste recycling in Qatar from 8% to 25% and to reduce the volume of domestic waste sent to landfill by 5% (Construction Week Online Middle East, 2013).

3.3 Regenerate natural systems

Circular economy avoids the use of non-renewable resources and preserves or enhances renewable ones – for instance, by returning valuable nutrients to the soil to support regeneration, through sustainable water balance or by using renewable energy as opposed to fossil fuels.

- a. **Execute renewable energy initiatives.** This involves identifying alternatives for power generation to cope with the rising demand resulting from population growth.

Renewable energy in the UAE

A regional example of a renewable energy initiative is the Shams Dubai solar program, which has allowed DEWA customers to install solar panels on their property and to utilise the solar energy produced to reduce their monthly electricity bills. Any surplus electricity that cannot be used is credited by DEWA at the retail rate, providing a further reduction in the electricity bills' (Dubai Electricity and Water Authority, n.d.).

- b. **Expand waste-to-energy strategies.** There is great potential to use waste as a source of energy, given the very high rate at which waste is created, providing a viable alternative to non-renewable energy sources.

4. Recommendations

There are many opportunities for the implementation of circular economy principles in the GCC countries. However, for these opportunities to be evolved and maximised, there is an urgent need for action at the policy level. Despite the differences between the cities in the GCC region, the strategic priorities with regard to transitioning towards a circular economy approach are common to all, and include the following:

- **Improving existing policies and regulations with regard to material and waste management practices in the built environment.** The UAE has been implementing some policies at the building scale; however, there is room for improvement on this front across the region to include the infrastructure and public realm elements. The construction sector should not continue being the major contributor to landfills.
- **Implementing policies and regulations that drive urban planning, design and construction practices to adopt the circular economy principles.** There is a need to revisit some of the existing policies and regulations regarding urban development throughout the region. For example, it would be beneficial to revise the land allocation policies across GCC countries to reduce urban sprawl, which would also then reduce the need for new extensive utilities and transport infrastructure. Improving accessibility through urban planning would reduce traffic volume and hence pollution. It is also important to develop and implement urban regeneration policies that prioritise the consolidation of existing activities and the optimisation of built assets to reduce the need for new builds. This is particularly relevant to some of the older city centres in GCC cities that were developed during the 1950s through to the 1980s, like Sharjah, Kuwait and Jeddah.
- **Developing energy policies and strategies to enable transition towards a more sustainable energy model is critical.** Some countries, like the UAE, Qatar and Saudi Arabia, have been developing energy policies and strategies, with the UAE leading on the implementation front. Others in the GCC region are yet to develop energy policies and strategies, and to revisit their tariff structure.

- **Revisiting the approach to water planning and management is paramount.** Policy and strategy are needed in this area to minimise the use of potable water, maximise the capture and treatment of stormwater and wastewater, and prioritise the use of treated water over potable water where possible. Revising the water tariff rates is also an important tool that needs to be considered. But integrated planning around the delivery of water infrastructure is essential. Some countries, such as the UAE, have begun to transform their approach to water planning and management to adopt a more sustainable model.
- **Promoting circular principles in the transportation sector.** Policies on mobility are among the areas where many opportunities for change exist across the region. The automotive industry is currently facing a challenge in relation to material availability, as it is a huge consumer of lead, which is expected to run out by 2030 (EMF, 2012). Recycling and refurbishing of existing vehicles – for example, by transforming ICE engine cars into electric vehicles by maintaining the vehicle body and replacing the vehicle engine – can significantly reduce the amount of vehicles manufactured from scratch. Furthermore, policies need to be developed that encourage the use of public transport, enhance cycling routes, optimise transportation journeys to reduce traffic, and put in place incentives to use electric vehicles to reduce carbon emissions. This will be essential to enable GCC countries to adopt the circular economy principles given the significant role played by transport in various economic activities and the intensity of its impact on society and the environment.
- **Encouraging building owners and developers to carry out lifecycle assessments of their assets.** This involves tracing the individual products that comprise a built asset over their complete lifecycles. The aim is to accurately measure all the costs and environmental impacts associated with a product over its life, including those related to dismantling, reuse and disposal. Lifecycle assessment can inform the decisions made at the early design stage and save costs by taking preventive actions.
- **Establishing a business and commercial case for the introduction of circular economy principles into the construction sector.** The construction sector can be significantly improved by enacting policies that provide investors, businesses and built environment professionals with access to data and digital platforms. This will empower different stakeholders to identify opportunities and create new delivery and operational models for the built environment sector. It is recommended that a comprehensive approach is developed, which addresses all the different factors that can contribute to the success of the construction industry, including:
 - a. higher education and professional training programmes;
 - b. governance and enforcement;
 - c. research and development with a focus on the distinctive features of the GCC.

5. Conclusions

The GCC countries are among the fastest developing in the world. However, at present their economies are largely based on a linear model, which follows a ‘take, make, dispose’ approach. In addition, the region’s resources consumption rates are among the highest globally. This is placing a significant strain on finite resources, locally and globally, and impacting the region’s natural resources as the demand for energy rises.

There are many factors driving the region to move towards a holistic approach towards circular economy. As of 2018, the GCC population reached 56 million people, with expected growth in the coming years, and a huge proportion of the population already living in cities. In addition,

current consumption patterns in the region are highly unsustainable, on both a domestic and a business level. The average global ecological footprint is 1.7 global hectares, approximately five times lower than the lowest ecological footprint in the GCC (Global Footprint Network, 2016). Since the construction sector in the GCC is one of the most fast-paced and highest-growth sectors, it could be a leader in the adoption of circular economy principles in the region. The circular economy model set by the EMF is based on three basic principles: designing out waste and pollution, keeping products and materials in use, and regenerating natural systems (Acharya, Boyd, and Finch, 2018). This report has provided an overview of the current state of play in relation to the business models utilised in GCC countries and has highlighted opportunities for intervention.

GCC countries are at various stages of exploring more sustainable policies and practices to ensure a better future for their citizens and residents. Policies and incentives are being developed to encourage green economies, resource efficiency and renewable energy strategies across the region. While efficient waste management, designing energy-efficient buildings and minimising the environmental impacts of waste are already in consideration, a game changer in the construction sector would be introducing alternative practices in the construction of real estate, as follows:

- Design future-proof buildings.
- Prioritise retrofitting/refurbishment rather than demolition.
- Embrace new business models, from adaptable assets to enhancing residual spaces.
- Develop policies and strategies for mobility and transportation.
- Ensure recycling procedures maintain material value.
- Implement performance procurement and the product-as-a-service model.
- Execute renewable energy initiatives.
- Expand waste-to-energy strategies.

There is a need for evidence-based projects and initiatives to evaluate the impacts of circular economy in various sectors, especially construction. There is currently not enough analysis to assess the future trajectories for the construction sector. Therefore, encouraging partnerships between stakeholders and companies that apply a circular approach to their projects will set a strong foundation in the region, paving the way for further progress in this area.







It will be important for GCC countries to establish common aims between stakeholders and policy-makers from project inception to operation. The 'business as usual' model will need to be reconsidered, driving the need for new jobs and skills and fostering opportunities for more collaboration across sectors, such as public-private partnerships.

Table 3 identifies the current challenges experienced at the different lifecycle stages in the GCC construction industry and potential solutions for a circular approach to overcome these challenges, considering the impact on capital and operational costs, the environment, new business, and green jobs and skills.

Table 3: Lifecycle consideration of buildings

Source: Authors
Graphics: Ninni Westerholm

C A P I T A L C O S T S

<p>MANUFACTURE</p> 	<p>Most building materials and products are imported. Due to the hot climate of the GCC region, running high energy processes is very costly; hence, the importation of materials is very common. Locally produced materials should be considered.</p>
<p>DESIGN</p> 	<p>Despite the existence of green building codes and guidelines, green design practices are not mainstreamed. Green design needs to build a strong case in the region, to be economically and environmentally attractive to investors and stakeholders.</p>
<p>CONSTRUCTION</p> 	<p>The construction sector does not consider reducing the use of expensive resources. Construction processes are heavily reliant on a linear model, with little consideration given to the end of life of materials and waste. Imposing a tax or a fee for waste could be a good incentive for green construction.</p>
<p>OPERATION AND USE</p> 	<p>In general, lifecycle thinking is not widely practised. The focus is usually on the capital costs; thus, operational costs are often not considered during the design stage. Stakeholders and investors are usually hesitant to invest larger amounts of capital to ensure end-of-life building use. There are clear opportunities to consider the true costs of resource use during operation.</p>
<p>RENOVATION</p> 	<p>Building assemblies need to become more modular, so that they are easy to repair and reuse. New enterprises could be set up to support the use of modular repair and reconstruction, supported by capacity-building.</p>
<p>DECONSTRUCTION END OF LIFE</p> 	<p>The value of the materials used is not considered during the building process. Materials used in buildings are usually thought of as having a one destination journey, without considering their potential use in other buildings.</p>

O P E R A T I O N A L C O S T S

MANUFACTURE



Materials are not necessarily manufactured locally, and local skills are not always used for local manufacture. There are untapped opportunities in the manufacturing process for water and heat recovery.

DESIGN



Operational factors and initial design need to be considered from the beginning. Passive design, renewable energy, water harvesting and design for durability should be considered upfront.

CONSTRUCTION



Promoting the use of modular elements in construction will reduce waste, improve quality and precision, reduce project time and reduce overall maintenance and waste.

OPERATION AND USE



Operational costs are almost never considered at the design and construction phase. If they were considered, options to lower energy and other utility expenses would lead to a better return on investment.

RENOVATION



The renovation of existing buildings, if properly undertaken, will support more affordable and easier renovation of assembly-based elements and a second-hand market will support access to used building materials.

DECONSTRUCTION END OF LIFE



Buildings are demolished rather than deconstructed. This is mainly because building design does not usually allow for a second usage. If materials are modular, it is easy to deconstruct and use them again. There is little waste, it is cheaper in the long run and buildings can be deconstructed and the materials reused repeatedly.

E N V I R O N M E N T A L I M P A C T S

MANUFACTURE



Currently, environmental impacts are often not considered during the various lifecycle phases. Increased use of bio-based and renewable materials would reduce dependence on the current extraction of natural resources to keep up with demand.

DESIGN



Design needs to support the reduction of material and energy footprints, and to focus on zero emissions throughout the lifecycle. Modular construction building methods are slowly finding their way into the GCC construction industry.

CONSTRUCTION



In the construction industry, waste is usually thought of as being sent to a landfill far away, with no consideration given to the broader environmental impacts. With less use of virgin materials, and reuse of existing materials, less waste would be sent to landfill. The choice of construction materials and techniques should be informed by the need to reduce emissions and waste.

OPERATION AND USE



The operational phase of buildings must be considered at the design stage. A longer life with no emissions or pollution, closed water loops and a focus on domestic nutrients recycling should support regeneration where possible.

RENOVATION



The environmental impacts of renovations need to be considered. Keeping materials and energy flow in the system can support value chains and reduce the waste and associated emissions produced by building from scratch.

DECONSTRUCTION END OF LIFE



The end of life of buildings has an environmental impact, especially if it ends in landfill. The reuse of construction and demolition waste reduces waste to landfill and associated emissions. The deconstruction phase should focus on reduced emissions and waste and consider the reuse of materials in a second life.

N E W B U S I N E S S E S

MANUFACTURE



New businesses have plenty of opportunities. Small to medium enterprises can support material production and material aggregation.

DESIGN



Design opportunities abound, with new innovations such as green design services and green certification and valuation. Skills in these areas need to be taught.

CONSTRUCTION



The construction sector should focus on circular construction practices and building passports should become the norm.

OPERATION AND USE



New business opportunities can be found in a range of areas, such as rental and shared ownership models across various sectors, including shared housing and other options of space-sharing. Local energy and water capture can support existing grids.

RENOVATION



The renovation sector has yet to be set up in the GCC region. There are opportunities for repair and renovation service providers, second-hand product suppliers and the like.

DECONSTRUCTION END OF LIFE



End of life opportunities for new business need to be considered, such as secondary resource aggregation services and new resource streams, to ensure that materials do not end up in landfill.

G R E E N J O B S A N D S K I L L S

MANUFACTURE



There are possibilities for the development of a new production workforce that possesses new skills related to the use of bio-based and other types of green materials.

DESIGN



In the design realm, new jobs for certification and rating consultants, green design skills and the like should be created. Education and upskilling in these areas are required.

CONSTRUCTION



The construction phase requires new assembly skills and green construction skills, which will need to be taught.

OPERATION AND USE



The building operational and use phase requires jobs for new management skills in relation to material aggregation platforms and rental and space-sharing businesses.

RENOVATION



People who can carry out retrofitting and repair will be in demand in a circular built environment. The use of local materials and technologies will provide jobs to locals.

DECONSTRUCTION END OF LIFE



There is already an informal economy in place for recyclers and the assembly workforce. This needs to be extended to the deconstruction phase of buildings.

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