

Boosting Circularity Across Saudi Arabia

A report by The Economist Intelligence Unit



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EXECUTIVE SUMMARY

- Saudi Arabia has experienced rapid economic growth, development and urbanisation in the nine decades since oil was discovered. In recent years there has been a growing realisation that this dominant linear economic model – where ever-increasing amounts of raw materials are extracted, processed, and turned into products which are then discarded at the end of their life – is unsustainable.
- Rather, Saudi Arabia should shift to a “circular economy” model – an economic model designed around eliminating waste as well as maximising the sustainable use and value of resources. To do so, companies and government bodies must design waste out of products and services and reduce, re-use, recycle or recover resources to the greatest extent possible. Consumers must consume less, but also consume differently – prioritising long-lasting products and leasing over owning.
- The circular economy is no longer a nice-to-have. Environmentally, the Kingdom has some of the world’s most polluted cities; it is more at risk from climate change (and a bigger contributor to it) than the majority of countries; and it has significantly degraded its limited freshwater and arable land through intensive agriculture, urbanisation and a reliance on landfills. Economically, the country needs to diversify away from oil and develop innovative, job-intensive, sectors – of which the circular economy promises many.
- Saudi Arabia does not yet have any formal legislation or national strategy for the circular economy. However, a number of environmental and sustainability policies have been adopted in recent years which may support a shift towards circularity – in particular, Vision 2030 and the National Environment Strategy.
- To accelerate this shift, Saudi Arabia will need to prioritise some initial focus areas. In this report, we examine municipal waste, food waste and municipal recycling – three interlinked areas where quick gains are possible and where Saudi Arabia currently lags (on a per capita basis, it is the biggest waster of food in the Gulf Cooperation Council (GCC), and recycles less than 10% of “recyclable materials”).
- To demonstrate the potential, we examine case studies from Chile, Denmark and China. Each offers compelling stories of progress, from new circular economy strategies, targets and progress metrics to dedicated research and innovation centres, and flourishing examples of “industrial symbiosis” – where one company’s waste products are transformed into inputs for another.
- We conclude our report with potential policies and actions that the Kingdom could employ to address barriers to circularity. Our recommendations include: providing national circular economy leadership through strategy and funding; creating incentives for circularity among firms and consumers; monitoring circular behaviour and tracking progress; building in-country capacity for innovation and localised solutions; developing public environmental awareness and ecological literacy; and leading regional circular economy collaboration.

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1. INTRODUCTION

Saudi Arabia has experienced rapid economic growth, population growth and development over the past 50 years, and indeed in the nine decades since oil was discovered. In 1969 it had a population of 3.8m;¹ today it has 34m.² Real GDP has tripled over the past three decades. Lifestyles have changed dramatically as the population has shifted from a rural and nomadic way of life, often in an austere desert setting, to a predominantly urban, literate, and middle-to-high-income society with high levels of car ownership, more mobile phones than people, and one of the world's largest carbon footprints.

Yet as with many rapidly growing countries, these dramatic changes have been environmentally detrimental. Saudi businesses, consumers and government bodies have had few incentives to protect the environment or to conserve resources such as energy and water. The exploitation of the world's largest reserves of oil has been the basis for rapid GDP growth, but has underpinned a model of production and consumption based on the intensive – and often wasteful – use of energy, water and other resources. Environmental legislation has been limited and often not implemented effectively. Affluence has been associated with high levels of consumption and the ability to acquire – and discard – new goods. Saudi Arabia now has one of the top ten per capita carbon footprints in the world, and Saudis have the highest per capita food waste in the world. The country's groundwater has been almost depleted in little more than a generation, and landfills are reaching a tipping point.

In recent years there has been a growing realisation that the Saudi economic model is not sustainable. This is especially the case because it depends on the exploitation of oil and gas resources which are finite, and which are significant carbon emitters. The country has been seeking to diversify beyond oil for many years and has adopted its most ambitious targets to date under the "Vision 2030" economic policy framework.³ Vision 2030 aims to achieve significant economic as well as environmental gains by adopting measures to limit waste, to recycle and re-use materials, and to develop renewable energy – in other words, to transition from a linear to a circular economy.

What is the Circular Economy?

In a linear economy, raw materials are extracted, processed, and turned into products which are then discarded at the end of their life. By contrast, the circular economy model is one that maximises the sustainable use and value of resources, eliminating waste and benefiting both the economy and the environment (see graphic below).^{4,5} Under this model, goods and services are produced in a way that minimises waste, emissions, energy and materials. The focus is on the “4 Rs”: reduce, re-use, recycle, recover.

It reflects a holistic way of thinking about the economy as an entire system, where waste is seen as a loss to the economy, and not merely a by-product or an “economic externality”. It recognises sustainability as a source of revenue and profit, rather than as a cost to be borne. A transition towards circularity requires a paradigm shift in thinking, so that consuming throwaway goods is not seen as a positive indication of economic growth. The concept has existed for decades but has gained traction as awareness of climate

change and the need for more sustainable economies has increased.

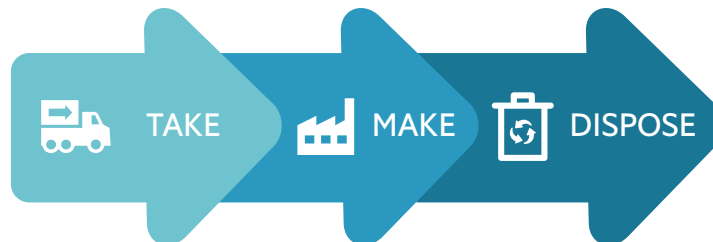
The MacArthur Foundation⁶ proposes three key principles for the circular economy:

- **Design out waste externalities** – most of the environmental impact of a product is determined at the design stage, so minimising waste at this early stage is critical. Product life cycles need to be extended. The very concept of built-in obsolescence (such as smartphones that need to be regularly replaced) itself needs to become obsolete.
- **Keep resources in use** – for instance, by re-using, mending, upcycling (transforming waste or by-products into new materials or products of a higher value), refurbishing, leasing and “remanufacturing” (rebuilding a product to its previous specifications).
- **Regenerate natural capital** – use renewable and re-usable inputs whenever possible, recognising ecosystems and the natural environment as a critical economic asset.

Going circular

The difference between the traditional linear economy model and a circular economy model

LINEAR ECONOMY



Technical and biological materials mixed up
ENERGY FROM FINITE SOURCES

CIRCULAR ECONOMY



Biological materials

Technical materials

ENERGY FROM RENEWABLE SOURCES

Source: EIT Raw Materials 2019

Birth of a concept

The circular economy is not new. In the Soviet Union, citizens were encouraged to sort their rubbish and received financial rewards for submitting scrap metal at collection points. Going back further, the economic historian Donald Woodward has described the importance of recycling to the economy of pre-industrial England, where there was a thriving trade in patched-up, second-hand clothes, and traders earned a living selling scrap metal and glass.⁷ The circular economy model also draws on systems from nature (such as the water cycle), and traditions of resource efficiency and frugality that were common in societies more accustomed to scarcity, including nomads and travellers.

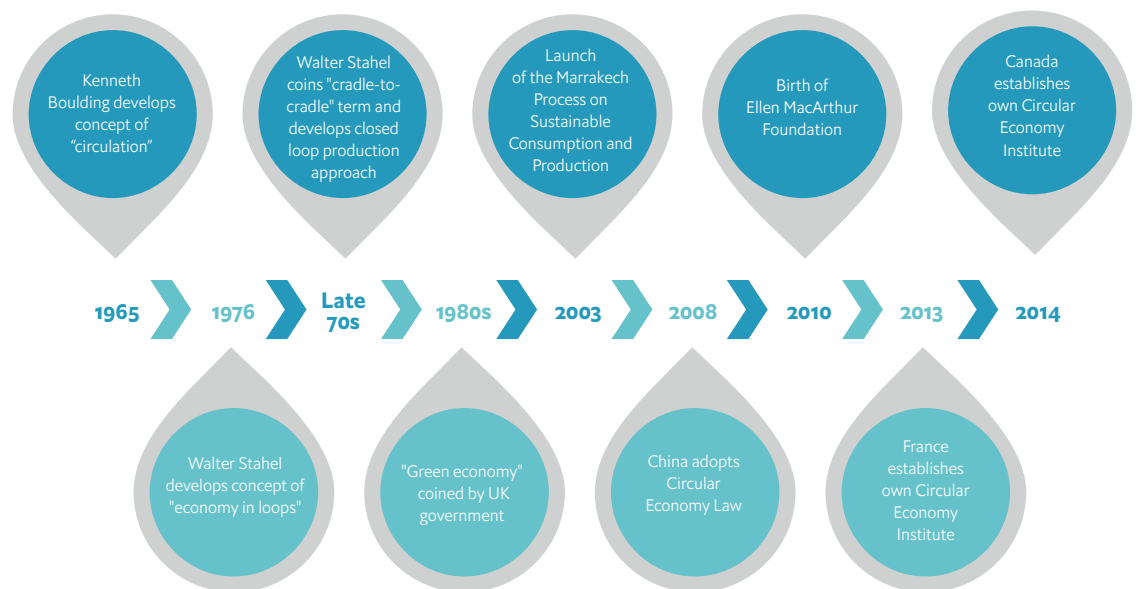
The American economist Kenneth Boulding first referred to the concept of resource “circulation” in 1965, when he published an essay introducing his “Spaceship Economy” theory.⁸ Boulding described two types of economy. The “cowboy economy”, the dominant model at the time and today, is characterised by notions of limitless resources and land. Consumption and production are always good (the more the better). If we exhaust one place we can simply find another one and

keep exploring. As Boulding outlined, this view is not consistent with reality. Instead, he argued for a “spaceman economy” which views the Earth as a single spaceship with limits for both extraction and pollution, and in which “man must find his place in a cyclical ecological system”.⁹ In the spaceman economy, there is a concern with stock maintenance and reducing consumption (for example, by producing things that don’t wear out quickly).

Walter Stahel’s 1970s model of the “functional economy” – which advocates maximising the use (or function) of existing resources – developed the circularity idea.¹⁰ But it wasn’t until the 1990s that it started to really gain traction, as awareness grew that climate change and the rapid depletion of finite resources were threatening economies and societies. The British environmental economists David Pearce and R. Kerry Turner were the first to use the phrase “circular economy” in 1990.¹¹ In the 2000s, Stahel’s idea of “cradle-to-cradle” design, which views materials as nutrients circulating in healthy, safe metabolisms – was developed further by product design thinkers to appeal to more socially conscious consumers.¹²

The circular economy concept has since been fleshed out by extensive research and reports by the Ellen MacArthur Foundation, established by a pioneering yachtswoman accustomed to conserving resources at sea. MacArthur and other circular economy advocates have proposed that natural and traditional approaches of conserving, re-using and regenerating should be combined with new technologies to minimise waste and boost sustainability. For example, in the case of waste management in Saudi Arabia, the implication would be that the country should shift from dumping rubbish in overstuffed landfills to building waste-based energy plants that use waste as a resource and a means to generate clean energy. China was one of the first large economies to pioneer and develop circular economy models. Since 2010 the concept has been increasingly referred to by policymakers and businesses, perhaps most prominently in Europe and Latin America.

Circular Economy: Key milestones



Source : The Economist Intelligence Unit

Environmental sustainability and ecological literacy

The circular economy is related to the concept of **environmental sustainability** – the ability of the environment to sustain economic activity without being irreparably damaged or destroyed by resource depletion. Environmental sustainability is one element of sustainable development – development that meets the needs of the present without compromising the ability of future generations to meet their own needs.¹³ Boosting environmental sustainability and shifting to a circular economy will require greater **ecological literacy** among the wider society – that is, people’s ability to understand the natural systems that make life on earth possible, and the principles that sustain life, such as energy

production and transfer. An ecologically literate person understands the origin of the resources that they consume, such as oil and water, and how they are processed. They understand the broader “systems” needed to sustain livelihoods and the interconnectedness between humanity’s actions and nature. They also understand the interconnectedness between local and global ecological systems, such as the effects of carbon emissions in Saudi Arabia on global climate change. Importantly, they understand both how and why human actions impact the ecological system, and what they can do about it. If a person has this understanding, they are more likely to support circular economy models.

Three dimensions of circularity

There are no entirely circular, waste-free economies, and even recycling requires energy. But across the world the approach of circularity is increasingly being used by companies, policymakers and non-governmental organisations (NGOs) to rethink and redesign how resources are used. Currently, the Saudi economy is a long way from circularity, given its dependence on non-renewable fossil fuels and its world-leading rates of waste generation. The shift to circularity will require action at micro, meso and macro levels.¹⁴

- The *micro level* describes changes in the behaviour of individual consumers, or the production and design processes of individual firms. For instance, some international textiles firms have adopted a “cradle-to-cradle” product design philosophy, in which only recyclable or biodegradable materials and chemicals are used, so that products can either be recycled or re-enter the natural biosphere.
- The *meso level* describes collaborative action taken between entities, such as firms in an industrial park. In China, policymakers want to transform industrial parks into “eco-industrial” parks. One approach is to identify areas of “industrial symbiosis”, where the waste produced by one firm is re-used or transformed into raw materials for another.
- The *macro level* describes action taken at a larger scale, such as at a city, national or potentially even global level. For example, the OECD and the European Commission have developed policy toolkits and dialogues to encourage city and regional governments to move towards circularity.¹⁵

2. WHY SAUDI ARABIA SHOULD EMBRACE A CIRCULAR ECONOMY MODEL

There are two primary imperatives for Saudi Arabia to embrace the circular economy: environmental and economic. At an environmental level, the country's rapid urbanisation, modernisation and population growth have taken a heavy toll, with clear effects on the country's biodiversity, heritage, and societal wellbeing. A circular economy would reassert the value of ecological resources and encourage new thinking about how to minimise waste, pollution and environmental degradation. At an economic level, a circular economy could help Saudi Arabia to diversify beyond its reliance on its oil resources – which are abundant but finite – and curb its world-leading levels of plastic and food waste, and transform what remains into an economic resource, rather than an economic drag.

The environmental imperative

As the environmental expert Peter Vincent once noted, Saudi Arabia is a land of spectacular scenery and contrasts, from the verdant mountain valleys of the high Asir region, to the endless dunes of the Empty Quarter and the black, basaltic, lava fields of the Arabian shield.¹⁶ However, the exploitation of the country's hydrocarbon reserves, and the intense urbanisation and modernisation that followed, have dramatically degraded the country's air, climate, land and water, with impacts reaching far beyond the Kingdom's borders. This degradation is advanced and unsustainable, and highlights why a shift to circularity is urgently needed.

Air pollution

Despite a shortage of publicly available data, studies suggest a growing air quality problem in Saudi Arabia. The pollutants of major concern include four gases – ozone, carbon monoxide, nitrogen dioxide and sulphur dioxide – as well as particulates of various sizes. The level of dust in the air is partly a consequence of its desert setting, but construction activity, automotive emissions, and fossil fuel extraction are the key causes of pollution.

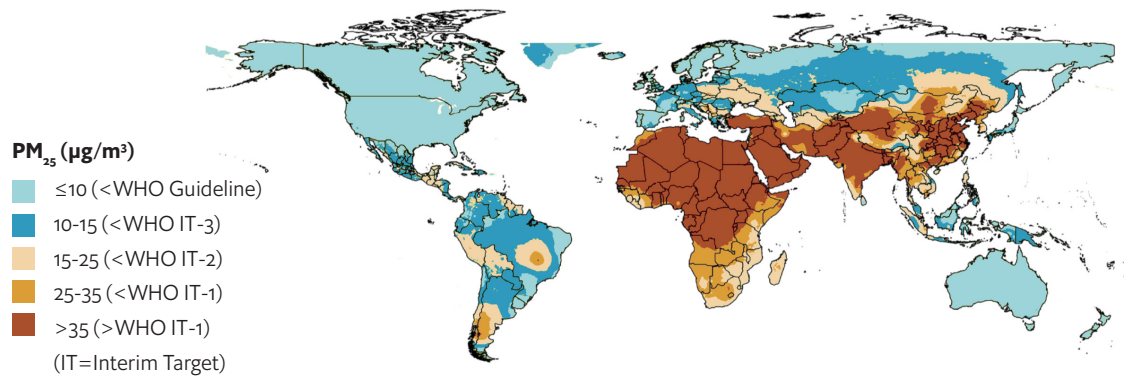
The World Health Organisation's (WHO) Global Urban Ambient Air Pollution Database measures the concentration of particulates in the air of more than 3,000 cities. The database measures particulates with a diameter of 2.5 microns (PM_{2.5}) and 10 microns (PM₁₀). When the two grades are averaged together, Riyadh and Jubail are among the world's most polluted cities. According to recent satellite data produced by Greenpeace, Riyadh is one of the world's nitrogen dioxide air pollution hotspots.¹⁷

Globally, air pollution contributes to around 3m deaths a year, according to the WHO.¹⁸ A 2014 assessment placed air pollution as the sixth-biggest risk factor for Saudi Arabia's overall disease burden, owing to its contribution to coronary heart disease, strokes, respiratory problems and lung cancer (among others).¹⁹ Air pollution also impacts the broader environment. Animals suffer from similar health problems to humans. Sulphur and nitrogen oxides from burning fossil fuels can also dissolve in clouds, resulting in acid rain that can directly damage vegetation, as well as polluting soils and freshwater. Air quality could be significantly improved by adopting more environmentally

friendly, circular product designs and consumer behaviour patterns (such as walking and car-pooling) that reduce emissions.

In the air tonight

Air quality in the Middle East is significantly worse than many other parts of the world (Particulate Matter, $\mu\text{g}/\text{m}^3$)



Source: State of Global Air Report 2019

Climate change

Owing to its intensive use of oil and gas, Saudi Arabia is estimated to be the world’s ninth-largest emitter of carbon dioxide, in absolute terms. In per capita terms, it is the world’s eighth-largest – and it emits more than three times the global national average. As a result, the country is a significant contributor to global climate change. It is also at risk from climate change. Indeed, some studies suggest that, on current trends, increases in average temperatures in Saudi Arabia will be higher than global averages, and that three-quarters of the country will suffer from excessive dryness by the end of the century.²⁰ Temperatures are already so high in summer that most Saudis depend on air conditioning and spend most of their time indoors; nearby Kuwait City holds the world record for the hottest temperature a city has ever reached. The case for moving to a more sustainable model in order to mitigate climate change is becoming increasingly compelling.

Besides rising average temperatures, climate change is also leading to more extreme weather in Saudi Arabia, with rainy seasons producing more intense rainfall, and dry seasons generating more extreme drought. This increases the risk of severe weather events such as cyclones and flash flooding. Climate change is also causing sea levels to rise, posing a threat to coastal communities and ecosystems in the Red Sea and the Gulf. One analysis found that 16% of the Red Sea coast was highly vulnerable to the impacts of climate change, particularly the region’s coral reefs.²¹ To forestall these looming effects, Saudi Arabia will need to embrace a shift away from exploiting and consuming fossil fuels – a shift that circular economy models could help to facilitate.

Land

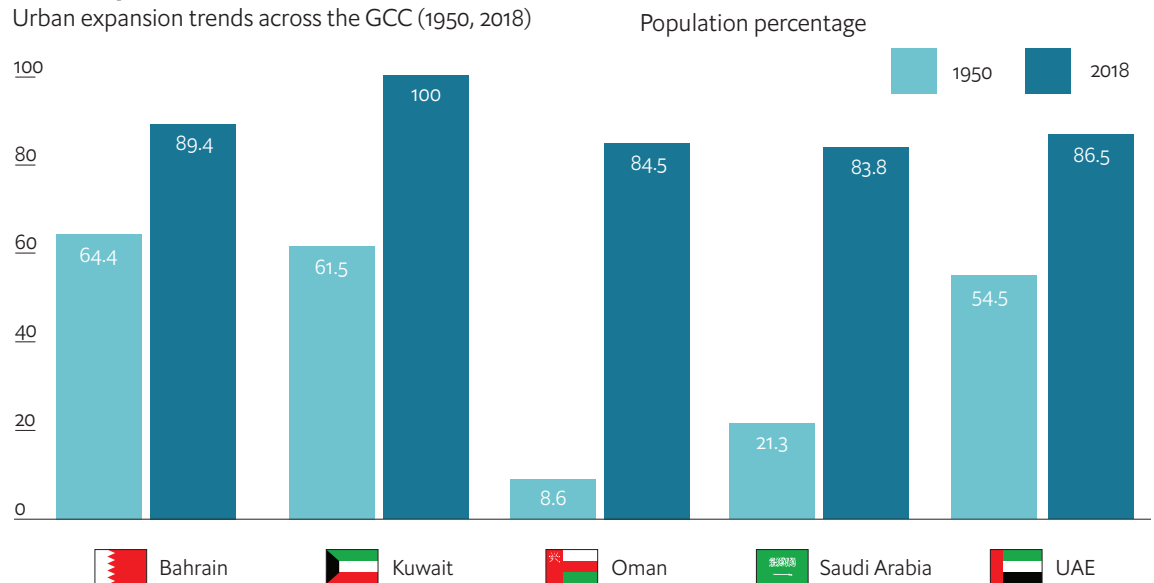
Construction does not necessarily damage the environment, but poorly planned construction does. In Saudi Arabia, decades of intensive urban expansion have imposed a heavy environmental

cost on the country’s land because it has not been managed sustainably. Urbanisation has been rapid: in 1950, 80% of the population lived in rural locations. By 2000, the same proportion lived in urban areas.²² New urban developments have often been rolled out with limited assessments of environmental and ecological impacts, and with insufficient regulation.

For instance, in Dammam, close to the centre of the oil industry, the urban area increased almost tenfold to support rapid population growth between 1973 and 2015.²³ As noted in a 2015 review, the majority of this urbanisation was unplanned and took place outside limits set by the local government planning department.²⁴ Taken as a whole, this urban sprawl had multiple negative effects on the environment. Valuable agricultural land, and ecologically sensitive land which cannot be reclaimed, was built on. Moreover, there is now little suitable land available for future development.

On the up

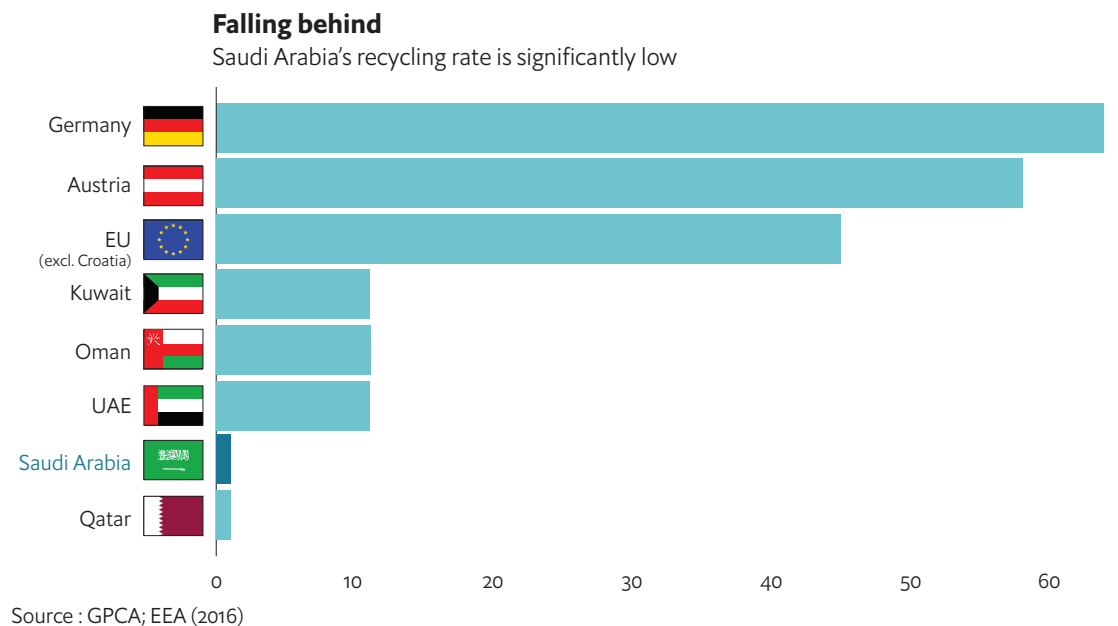
Urban expansion trends across the GCC (1950, 2018)



Source: United Nations (2018)

Beyond of construction, landfills are also hurting the Kingdom’s land. As noted in a recent study, most landfills in Saudi Arabia are on the brink of reaching their capacity as both production and consumption patterns tend to generate significant waste, with limited awareness of the problems this causes.²⁵ Consumers make heavy use of disposable products, notably single-use plastics. Saudis consumed 95kg of plastic per person in 2016 according to the Gulf Petrochemicals and Chemicals Association, which also noted that consumer packaging accounts for 44% of GCC plastic consumption.²⁶ A 2016 report by the Riyadh Exhibitions Company, widely cited in local media,²⁷ claimed that Saudis consume more plastic bags than consumers in any other Middle Eastern country. Moreover, waste management policies have not kept pace with demographic and economic growth patterns, or with international best practice. Recycling is limited. The majority of municipal waste is disposed of, untreated, in landfills, while some is incinerated. Once the landfill sites are full, the

land typically cannot be used for other purposes. Moreover landfills in Saudi Arabia are usually not engineered to limit their harmful effects. Beyond being an eyesore, landfills result in harmful leachate (permeated liquids) and emit greenhouse gases, which negatively affect the climate and pollute Saudi Arabia’s vital yet increasingly depleted groundwater supplies. Adopting more circular economy practices, such as encouraging the reduction of waste and increasing rates of recycling, would significantly ease the pressure on landfills and their polluting effects.



Water

Freshwater is scarce, owing to Saudi Arabia’s arid climate and landscape. According to the UN Food and Agriculture Organisation (FAO), the country receives an average of just 59mm of precipitation annually – one of the smallest amounts globally.²⁸ On the demand side, Saudi Arabia is among the world’s top five consumers of water in per capita terms. The vast majority of demand comes from the agricultural sector.

Intensive farming has severely depleted the country’s groundwater resources, with estimates that 80% of groundwater reserves are now exhausted (although timely data is lacking).²⁹ A recent *National Geographic* report noted how one of the world’s oldest groundwater reserves in one of the world’s hottest places had been depleted in little more than a generation.³⁰ The Ministry of Environment, Water and Agriculture’s national environment strategy³¹ notes that, at current rates of depletion, Saudi Arabia will run out of groundwater in 60 years – before it will run out of oil.

Most of the country’s water is now provided through desalination, which is energy-intensive but has been affordable to date because of the low, subsidised cost of fossil-fuel-based energy. However, most desalination methods increase the salt content of the water that remains in the sea, which is detrimental for marine life. It also makes future desalination more costly because there is more salt to remove. The Gulf’s waters are already 25% saltier than the global average.³¹

Moving towards industrial and consumption models that limit the wasting of water, as in a circular

economy model, will help reduce these pressures. Professor Raimund Bleischwitz at University College London notes that “a well-applied circular economy concept in Saudi Arabia would minimise and optimise the use of water, through efficient water infrastructure, distribution and usage...which would be an obvious priority for a water-stressed region.” Patrick Schroeder at Chatham House notes that water re-use is an area of the circular economy in which Saudi Arabia is performing relatively well, and where it can provide models for other countries. More than half the country’s wastewater is treated and recycled, and water-treatment plans are being developed with a view to recycling all of the water used in major cities.

Other positive shifts are also emerging. Heavily subsidised water enabled Saudi Arabia to become a major wheat exporter in the 20th century, but since 2000 there has been a shift towards less water-intensive agriculture because of growing concerns about groundwater depletion. As with the growing interest in renewable energy, the move towards more water-efficient agriculture is an indication of the gradual evolution of thinking about sustainability and natural resources in Saudi Arabia in recent years.

The economic imperative

A number of studies have suggested that moving to a circular economy can have a positive impact on growth and job creation, as economies use resources more efficiently and extract more value from what they have.³³ The circular economy model can also provide a basis for new, innovative business models that do not necessarily depend on consuming, throwing away and buying something new. Through the sharing and leasing economy, for instance, small businesses and micro-entrepreneurs can become service providers, facilitated by low-cost and open-access technological platforms, without needing to invest capital in production. Consumers can reduce the money they spend on disposable materials and use it for more long-lasting and innovative products and services. The circular economy also reduces threats to future growth that come from unsustainable patterns of resource use. It takes account of the depletion and waste of natural resources as a loss to the economy which is not captured in existing GDP measures.

The circular economy concept is becoming more relevant to Saudi Arabia as it seeks to diversify beyond its reliance on oil resources, which are abundant but finite. The country’s economic model has for decades been based on its ability to export more oil than any other country, which has enabled vast improvements in living standards but has also paid for unsustainable consumption patterns. Some of the oil wealth has been reinvested in infrastructure and human capital, but much of it has paid for the public-sector wage bill, subsidies and services (which make up the vast majority of the government budget – itself usually 80–90%-funded by oil exports).³⁴

However, the approach to managing oil wealth is gradually changing, and there has been a growing realisation that it is wasteful and inefficient to consume so much of the country’s oil instead of exporting it. Policymakers are also aware that relying on oil is economically unsustainable, both because it is a finite resource that is being depleted, and because of potential long-term risks to world oil demand. Moreover, the oil sector is resource-intensive but not labour-intensive: it cannot create the jobs the country needs. The current economic development framework set out in Vision 2030 is designed around diversifying away from oil and developing new productive sectors.

According to a study by PricewaterhouseCoopers Strategy & Ideation Center, a circular economy model could generate up to US\$138bn (SAR 518bn) in economic benefits for the GCC between 2020 and 2030.³⁵ These benefits would largely arise from enhanced competitiveness, a lowering of environmental pressures and costs, making raw material supply chains more secure, boosting industry innovation, and generating new jobs. Another primary opportunity is the reduction and more effective management of waste. As one example, the Ideation Center study estimates that by integrating circular economy approaches into the construction industry, GCC companies and government entities could potentially save US\$23bn (SAR 86bn) over the next ten years, including by reducing and re-using waste. The construction industry produces the most waste of any sector: 35–40% of the waste in the region, compared with 25–30% in the EU.³⁶

3. THE CURRENT STATE OF THE CIRCULAR ECONOMY IN SAUDI ARABIA

Saudi Arabia does not yet have any formal legislation or national strategy for the circular economy. However, a number of environmental and sustainability policies have been adopted in recent years which may support a shift towards circularity. In particular, Vision 2030 – the government’s overarching framework for economic development, launched in 2016 – focuses on moving the economic model away from the unsustainable depletion of the country’s key resource, oil, and seeks to make better use of its resources in general. Both Vision 2030 and the National Transformation Plan (NTP) - the current five-year development plan under the Vision framework - include key targets to help the country achieve environmental sustainability. These do not use the language and concept of the circular economy, but have given rise to several circular economy initiatives.

In 2018, the Ministry of Environment, Water and Agriculture issued a briefing for the Council of Economic and Development Affairs outlining the country’s National Environment Strategy, which offered a thorough review of the state of environmental policy and called for a “comprehensive framework for the implementation of radical solutions”.³⁸ Its wide-ranging aims include developing the governance of the environment, reducing pollution, and promoting the private sector’s role in improving sustainability. It also seeks to enhance the quality and coverage of weather data. The ministry acknowledged the need to mainstream climate change into national economic development policies, and noted the role of emissions from landfills as well as the larger issue of hydrocarbon consumption. The strategy acknowledged an absence of frameworks for private-sector participation in improving sustainability, for instance in the waste sector. It also pointed to the lack of incentives for green business, such as soft loans or subsidies.

The ministry’s key performance indicators (KPIs) include raising Saudi Arabia’s ranking in the Environmental Performance Index (EPI) to 50th by 2030 from 86th in the 2018 index.^{39,40} This would require concerted action to address all types of environmental degradation. The EPI is a global benchmark developed by Yale University and Columbia University, together with the World Economic Forum. Saudi Arabia’s ranking has already improved from 95th in 2016. Also of note is the

Ministry of Economy and Planning's commitment to align policy with the Sustainable Development Goals (SDGs); Saudi Arabia participated in its first voluntary SDG review in 2018, and its review document briefly cites the circular economy concept.⁴¹

A National Environmental Awareness and Sustainable Development Programme is also being implemented in conjunction with a number of public agencies, NGOs, and international organisations such as the United Nations Development Programme and UN Environment. Its stated short-term goals are to promote environmental awareness and environmentally friendly behaviours, while long-term goals include enacting new laws.⁴² The General Authority of Meteorology and Environment Protection is also reportedly planning to establish an "environmental police force" to tackle illegal hunting and deforestation.⁴³

Outside of these national-level environmental initiatives, a variety of corporate activities and government policies are emerging in Saudi Arabia that show support for circular economy models. Below, we examine activities and policies in three interlinked priority areas: municipal waste, food waste and municipal recycling. These areas were selected on account of their high potential for reducing net waste, generating cost savings, and creating new jobs in Saudi Arabia. There are also clear opportunities to make rapid progress in these areas, which could help with longer-term efforts to move Saudi cities, and eventually the national economy, towards a circular economy.

Priority area 1: Municipal waste

The OECD defines municipal waste as waste collected by municipalities, including rubbish from households, shops, street trading, small businesses, street cleaning, and yard and garden waste. According to the World Bank, the world produces over 2bn tonnes of municipal waste annually, at least one-third of which is not disposed of in an environmentally safe manner. Moreover, waste management typically takes up 20–50% of global municipal budgets.⁴⁴ Reducing waste can therefore result in:

- Significant cost savings for local government
- Enhanced use of resources
- Reduction in pollution and environmental hazards.

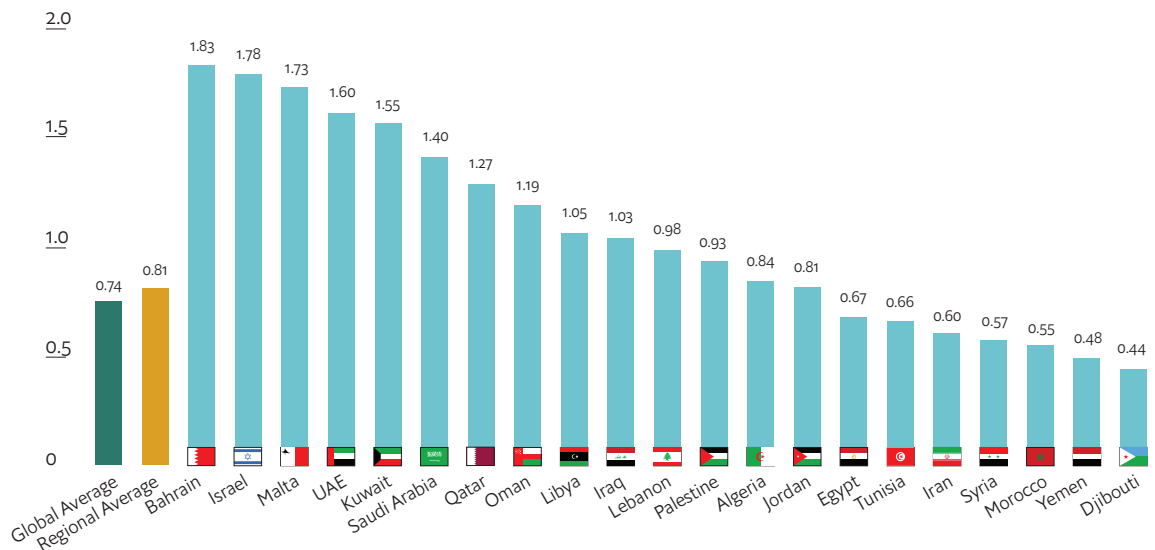
The challenge facing Saudi Arabia

Saudi Arabia generated a daily average of 1.40 kg of solid waste per capita in 2016, up from 1.15 kg per person in 2010⁴⁵ – a figure far higher than both the regional average (0.81 kg) and global average (0.74 kg) (see graphic below).⁴⁶

Tipping point

Per capita waste generation in the MENA region (kilogram per person per day, 2016)

Kilogram/person/day



Source: World Bank Group (2018)

According to various sources, roughly half of this is made up of food and other organic materials (further discussed below).⁴⁷ Data on the composition of waste is limited, but BioEnergy Consult, a consulting firm specialising in industrial waste management, estimates that the remainder comprises paper (12–28%), cardboard (7%), plastics (5–17%), glass (3–5%), wood (2–8%), textiles (2–6%), and metals (2–8%).⁴⁸ A 2016 study notes that there are particularly high levels of plastic waste during the annual Hajj (Islamic pilgrimage season) when millions of travellers visit the holy cities of Mecca and Medina.⁴⁹ Food waste also increases significantly during Ramadan because of the large quantities of food prepared for evening iftar (fast-breaking) celebrations, which are important social events.

At present, most municipal waste is collected, compressed and dumped in landfills. Most recyclables are not recycled. Organic waste is usually not separated from other forms of waste, which results in methane emissions as food rots. Landfills are typically non-engineered, and waste is left largely untreated, which leads to the pollution of land, water and air. Overall, because of the lack of source segregation and recycling, many materials are going to landfills which could instead be re-introduced to the value chain were a circular economic approach promoted.

Existing policy support

Under the Vision 2030 “Achieving Environmental Sustainability” programme, Saudi Arabia aims

to establish comprehensive recycling facilities and make waste management more efficient. The participation of the private sector and government funds are sought in these efforts. The NTP for 2018–20 also includes the objective of reducing all types of pollution, including soil pollution from non-biodegradable waste.⁵⁰

In July 2019, Riyadh launched a city-wide waste management and recycling plan, with a target to recycle 81% of its municipal waste by 2035.⁵¹ The recycling project was launched as a joint initiative between Riyadh Municipality, the National Waste Management Center, and Saudi Investment Recycling Company (SIRC).

Emerging circular economy activities

SIRC has stated that it will invest in waste-to-energy plants to contribute to the country's target of generating 3GW of waste-to-energy capacity by 2030.⁵² A priority goal is to make waste-to-energy more cost-efficient. The future cost viability of a waste-to-energy scheme in Saudi Arabia will depend on energy tariffs and the relative costs of competing gas-and coal-fired power plants in the energy mix (which, in turn, depends on government subsidies).

In terms of other waste-to-energy projects, in 2018 Saudi firm Sadara and France's Veolia signed a memorandum of understanding to build a sustainable utilities plant in the industrial city of Jubail.⁵³ The aim is to produce industrial steam, cooled water and compressed air from the incineration of industrial waste.

Priority gaps to address

High levels of waste reflect a society where re-using and recycling are not yet the norm. Internationally, the World Bank advises that citizen engagement in reducing waste is vital, as municipal waste reduction depends on behaviour change. In Saudi Arabia, supportive education and public-awareness campaigns are lacking.

Incentives are also lacking. A large proportion of Saudi Arabia's non-recycled waste is in the form of plastics since there are few incentives to curb single-use plastic. It is estimated that more than 90 countries have some form of ban or restriction on the manufacture, importation and retail distribution of single-use plastic bags.⁵⁴ Historically, Saudi Arabia's relative lack of action in this area may have been partly due to its status as a major plastic producer. However, this is starting to change. The state petrochemicals giant, SABIC, has of late announced more recycling and circularity practices.⁵⁵ For instance, its "certified circular polymers" have recently begun to be used by Tupperware in re-usable straws and coffee cups.⁵⁶

Priority area 2: Food waste

Food waste is defined as “discarding or alternative (non-food) use of food that is safe and nutritious for human consumption”.⁵⁷ The UN FAO estimates that one-third of the world’s food production is either lost before reaching market or wasted (thrown away before or after it spoils), even as hunger is increasing globally. Food waste, which is the “single-largest component of landfills”,⁵⁸ is also a leading contributor to climate change. Food that ends up in landfills produces methane as it rots, which warms the planet even faster than carbon dioxide. Globally, food waste generates roughly 8% of human-caused greenhouse gas emissions. Yet most of it could be composted or turned into new products: South Korea now recycles 98% of its food waste.⁵⁹

Reducing food waste can therefore result in:

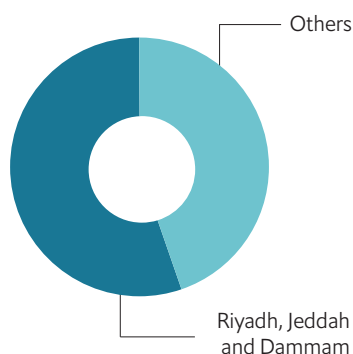
- Environmental benefits from reducing waste sent to landfills
- Economic benefits for households (lower food bills) and farmers, restaurants and processors (lower disposal costs)
- Social benefits through a redirection of food to emergency food providers (reducing hunger).

The challenge facing Saudi Arabia

According to The EIU’s 2016 Food Sustainability Index, Saudi Arabia generates the highest amount of food waste per capita in the GCC region. The Ministry of Environment, Water and Agriculture estimates the cost of this food wastage at SAR49bn (US\$13bn) per year, a figure that could increase to over SAR65.6bn (US\$17.5bn) by 2020.⁶⁰ Much is wasted in hotels, restaurants, and at social functions such as weddings, and around half of food waste is produced in the three major cities of Riyadh, Jeddah and Dammam.

Where does Saudi Arabia’s waste come from?

Almost half comes from three of its most populated cities



Source: Saudi Gazette (2018)

Providing large quantities of food is associated with hospitality, on which Saudi society places a high premium, to the extent that it is typical to have large amounts of leftovers at the end of a meal, especially when entertaining or celebrating. A 2017 YouGov study across Saudi Arabia, UAE and Egypt found that the biggest source of food waste was restaurants (accounting for 32%), followed by surplus food provided for celebrations which is then thrown away (30% of total waste).⁶¹ Nearly half of wasted food is already cooked, thereby wasting energy.

Food waste is particularly inefficient for Saudi Arabia because the vast majority of food (80–90%)

is imported. According to some estimates, 30% of food waste is cooked rice, and rice is imported.⁶² Moreover, local food production (such as dairy products, which consumers prefer to source locally) uses up scarce water resources.

Existing policy support

In Saudi Arabia, as in the rest of the GCC, food security has moved up the policy agenda since the international food price spike of 2008, which pushed up inflation and subsidy costs, given the Kingdom's dependence on imported food. This growing focus on food security, along with a desire to reduce the government's subsidy costs, has encouraged policy-thinking about food waste.

In 2017 the Ministry of Environment, Water and Agriculture set up a committee to review ways of reducing food waste. The following year, local media reported that the Saudi government planned to review a proposed law to combat food waste. One suggestion was that restaurant diners could be fined for leaving food on their plates, although this could encourage unhealthy eating habits and does not appear to have been pursued. There were also local media reports that the Shura Council – Saudi Arabia's formal advisory body – sought to implement legislation to penalise businesses and individuals who waste food.⁶³

In December 2019, Saudi Arabia's Eastern Province municipal council also announced plans to regulate food waste in hotels and wedding halls by preventing them from renewing their licenses without first signing a contract with a food protection society.⁶⁴

To date, hard regulations and fines for food waste remain largely absent. However, the Ministry of Environment, Water and Agriculture has stated that food waste and sustainable agriculture will be among the priority topics for discussion at the G20 summit that Saudi Arabia is due to host in 2020.⁶⁵ Further, the Saudi Grains Organisation (SAGO) also announced plans to implement a legislative framework that builds in rules to reduce food waste across the Kingdom.⁶⁶

Emerging circular economy activities

The Riyadh Municipality is piloting food recycling through its "City without Containers" programme, which requires households to use a "two-bin system" to separate organic/food waste from all other waste.⁶⁷ Instead of going to landfill with non-recyclable rubbish, food waste can therefore be composted. Source-segregation of this kind is viewed as a prerequisite for efficient recycling infrastructure and is widely employed in other countries. Composting is becoming more commonplace in Saudi Arabia, with food waste used as a basis for natural fertiliser. (Given the poor quality of much of Saudi Arabia's soil, the agriculture sector has traditionally made heavy use of chemical fertilisers, which has contributed to the release of nitrous oxide and harmed some sources of freshwater.)

As for civil society initiatives, since 2011 the Al Fozan Foundation has operated a food bank, Itaam, which takes unused food from food courts and distributes it to the needy.⁶⁸ It is described as "the first Saudi food bank", but builds on long traditions of charity and almsgiving. There are now an estimated 30 similar initiatives around the country.⁶⁹ As well as redistributing food, Itaam has worked with the private sector and international organisations to raise awareness of food waste and encourage redistribution. In 2018 it signed an agreement with Dow Chemicals, one of the major investors in Saudi Arabia, to set up a pilot educational programme in schools in Jubail, to teach

young people about food waste, healthy eating, and how to preserve food.⁷⁰ It also has an initiative with Savola, one of the country's largest food conglomerates, to encourage hotels, restaurants and consumers to conserve and use food more efficiently.

Priority gaps to address

In the 2017 YouGov survey on food waste in Saudi Arabia, UAE and Egypt, two-thirds of respondents claimed that food waste could be reduced if more was done to increase awareness of the problem. As food consumption is often a social activity in Saudi Arabia, social norms and perceptions are particularly important. There is a need to shift mindsets so that conserving food is seen as responsible rather than miserly. This is also linked to the need to shift social norms so that large amounts of excess food are no longer seen as socially desirable.

A 2018 study by Saudi scientists found that there was a need to change the "food culture", especially among the youth who make up the majority of the population, by educating them about the benefits of reducing food and water waste, as well as ways of doing this such as better planning of shopping and use of leftovers (which, it noted, some Saudis think is unhygienic).⁷¹ It also noted that subsidies keep the cost of many foods artificially low and suggested that there should be financial penalties for throwing food away unless it is recycled.

Itaam, the food bank, proposed in 2018 that the authorities should make it mandatory for restaurants and wedding halls to make arrangements with food-preservation centres which could redistribute leftover food. It also suggested that the authorities could charge people for each kilo of food thrown away. The 2018 Saudi scientists' study suggested considering a version of a law passed in France in 2016 that requires retailers to donate excess food to charities to redistribute.

Saudi scientific studies have also proposed using food waste for biogas and biofertiliser production.⁷² Dubai, which does not have its own oil exports, already has several biofuel plants and uses biofuel made from used cooking oil in its municipal buses, produced by a local company, Neutral Fuels. Saudi Arabia does not yet have start-ups operating in this space, but if it could provide a framework to enable them, similar projects could be launched in the larger Saudi market.

Priority area 3: Municipal recycling

The recycling of municipal waste is a process by which useful materials are recovered from items that are thrown away in order to be re-used. Different types of material have different recovery rates. Composting of organic waste is usually separated out from recycling (of man-made materials) in statistics on waste recovery and re-use, although both use the same basic principles of circularity.

Municipal recycling programmes can be complemented by other recycling programmes run by NGOs, social businesses and the private sector. Across the world, retailers run schemes to encourage consumers to recycle bottles and caps (by charging a deposit that is refunded once the bottle is returned), for example. Many countries also require producers to take some responsibility for the recycling of their own products, as part of broader "Extended Producer Responsibility" plans. Across the Middle East, start-ups have emerged that focus on helping individuals and companies recycle. One example is the Egypt-based RecylcoBekia, which partners with the private sector to take its "e-waste" and recycle it. Another youth-led Egyptian start-up, Napata, uses palm waste to produce

accessories that are handmade by women who are trained in traditional arts.

Globally, there is considerable debate over the socially optimal amount and type of municipal recycling. Policymakers need to weigh up the environmental damage caused by different types of waste; the economic cost of recycling different types of materials (it is usually more expensive for municipalities to recycle household waste than to send it to landfill); the obligation imposed on individuals; and the economic value of different recycled materials (for example, metals are typically worth much more than plastics). Despite these caveats, there are significant benefits to enhancing municipal recycling rates, particularly for harmful metal, paper and plastic products, namely:

- Creation of a new recycling industry (new jobs, for instance)
- Reduction of waste pollution and use of virgin resources
- Reduction of damage caused by landfills (including aesthetic damage)

The challenge facing Saudi Arabia

As noted above, one of the primary reasons for high rates of municipal waste in Saudi Arabia is low recycling rates. According to a 2019 Bloomberg report citing studies by Saudi Arabia's Public Investment Fund (PIF), the country produces 50m tonnes of recyclable materials each year but recycles no more than 10% of them.⁷³ The main recycling activity in Saudi Arabia focuses on metals and cardboard, which make up 10–15% of the total waste. This recycling practice is mostly carried out by informal "pickers", while a regulatory framework for formal participation has been lacking.

Existing policy support

One of the three pillars of the NTP is to "ensure the sustainability of vital resources". The 2018–20 NTP delivery plan focuses more on waste management than on recycling, although it does plan to work with the private sector to fund comprehensive recycling projects. John Kalogeras, Vision 2030 Lead at Hewlett Packard, notes that "Improving national levels of waste recycling and re-use is at the top of Saudi Arabia's agenda for utilising circular economy disciplines to tackle its economic and environmental imbalances." As noted above, the National Waste Management Center plans to help develop the regulatory environment for recycling as well as waste management.

Emerging circular economy activities

The PIF established SIRC to invest in and operate waste management projects, from waste treatment and recycling to waste-to-energy programmes. It has the ambitious aim of achieving an overall recycling rate of 81% by 2035. This compares with 54–68% in leading recycling countries such as the Netherlands and Germany. The target may thus be best seen as an indication of ambition rather than a forecast. SIRC also aims to contribute more than US\$10bn to GDP and create 23,000 new jobs by 2030.

Annually, the Riyadh Municipality produces 3.4m tonnes of municipal solid waste and 8m tonnes of construction and demolition waste. To tackle this, SIRC recently signed a tripartite memorandum of understanding with the National Waste Management Center and the Riyadh Municipality to start recycling activities in Riyadh and reduce waste dumping in landfills. The memorandum aims to reduce Riyadh's annual solid waste by 81%, and construction and demolition waste by 47%, by 2035.⁷⁴ To the latter end, SIRC has acquired Global Environmental Management Services (GEMS), an industrial waste recycling company. It is now planning to expand GEMS' capacity in Saudi Arabia and export the locally developed technology.

The Saudi Standards, Metrology and Quality Organization (SASO) has also introduced rules to ensure that plastic products must be made of an approved oxo-biodegradable material – a plastic that degrades at a much faster rate than ordinary plastic, and without releasing methane⁷⁵ - and bear a “biodegradable” logo. This is being phased in through to April 2020. However, these materials are controversial and are banned in France and Spain because of concerns that they may remain as microplastics in the long term, while in the short term the chemical treatment required makes recycling challenging.

The municipality of Mecca launched a recycling initiative in 2018 with thousands of workers on hand to sort through the estimated 42,000 tonnes of waste produced by close to 2m pilgrims during the holy month. Recyclable goods were sold for recycling with proceeds donated to charities. Local media noted that banners with a green “recycle” logo were hung close to the holy Kaaba inside the Grand Mosque, and that the authorities wanted to appeal both to environmental ethics and to religious beliefs to cut waste. In 2019 SABIC began to produce certified circular polymers made from recycled low-quality plastic waste which would otherwise have ended up in landfill.⁷⁶

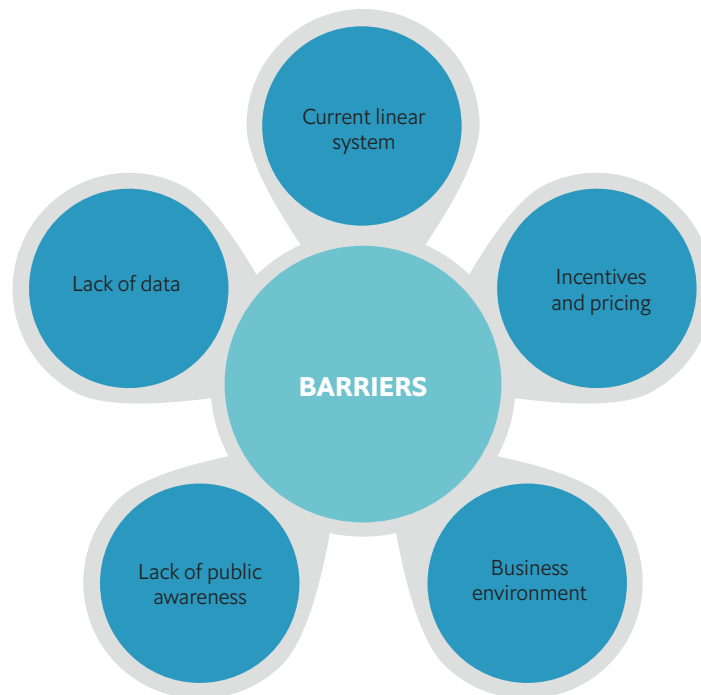
Priority gaps to address

Recycling in Saudi Arabia is hindered by the fact that most waste is not sorted at source. The two-bin recycling system, currently being piloted in Riyadh, needs to be rolled out across the country. Another area that has been explored internationally is using the informal litter-picking sector to bring benefits to the formal economy, by creating new jobs and enabling the sector to benefit from new technologies. As with the broader municipal and food waste challenges, public awareness incentives to recycle remain limited, although the increasing international focus on single-use plastic is having some impact on globally connected Saudi youth.

The roadblocks ahead

The analysis of the three priority areas above illustrates how Saudi Arabia faces some clear obstacles to becoming a more circular economy.

Saudi Arabia's barriers to circularity



Source: EIU

Current linear system

The Saudi economy has developed over the last century on the basis of windfall wealth from oil and gas – a sector based on extracting and depleting resources. Saudi policymakers are well aware of the need to conserve and re-use some of the country's oil wealth, in particular by investing the capital derived from oil in infrastructure and human capital development. The country has therefore used some of its oil wealth to develop a wider range of industries and services. In particular, its comparative advantage in terms of energy has provided a basis for energy-intensive industries such as petrochemicals, plastics and aluminium. However, most of the government revenues generated by oil have been used for social spending, and Saudi Arabia has only recently developed a significant sovereign wealth fund. There are also concerns that energy-intensive industries are based on a strongly linear model of resource depletion. As Saudi Arabia looks to an eventual post-oil future, it is interested in developing more sustainable patterns of production, reducing waste, and moving environmental protection higher up the policy agenda.

Transitioning towards circularity will enable Saudi Arabia to reap significant environmental and economic rewards by augmenting the productivity and value of its resources and minimising value leakage. This is prompting some policy-thinking about sustainability, but old habits die hard. Government incentives are designed to support a linear economy, and products are not designed for

circular business models. There are also a number of barriers to entrepreneurship and private-sector innovation which may hold the country back from developing new business models for the circular economy.

Incentives and pricing

Incentives, including pricing, are part of the policy toolkit that governments can use to shift consumption patterns, but also need to be weighed up against societal expectations. Saudi consumers and businesses have long been accustomed to low-cost energy and water. This has traditionally limited the incentives for them to reduce consumption. Some changes have begun: in particular, energy prices have increased significantly since the introduction of Vision 2030 and there have also been some increases in water tariffs. In December 2015, the country launched a five-year energy subsidy reform programme. Petrol prices increased from SR0.60 (US\$0.16) to SR0.90 (\$0.24) per litre for high-grade Octane 95, and from SR0.45 (\$0.12) to SR0.75 (\$0.20) for Octane 91. However, Saudis still pay considerably less for water, petrol and electricity than other consumers, both in the region and globally, and there continues to be a strong social expectation of low-cost access to these resources, given the country's oil wealth.

Business environment

The Ministry of Environment, Water and Agriculture's 2019 national strategy acknowledges that Saudi environmental regulations do not cater for private-sector participation. For instance, regulatory frameworks for waste management and recycling are nascent, and there is no role for the private sector in monitoring compliance with environmental regulations. Meanwhile, there are few incentives, such as soft loans, for green business start-ups, and in general the business environment is more geared towards large local and international players than to facilitating innovative start-ups. Private-sector initiatives promoting sustainability tend to come from large international players.

Public awareness

The circular economy model is associated with ideas of environmental stewardship and ecological literacy. Public awareness of environmental challenges is limited. According to one Saudi researcher, young people find it difficult to appreciate the problems caused by rising global temperatures since they already live in an extremely hot climate.⁷⁷

The idea of man-made climate change was historically seen by the Saudi government as a potential threat to demand for its key export, oil. As a result, the authorities resisted educating the public about the problem for some time. Saudi Arabia did ratify the 1997 Kyoto Protocol and the 2015 Paris Agreement, yet as recently as the COP summit in December 2018, it joined the US, Russia and Kuwait in blocking a resolution that would have welcomed a landmark report on global warming by the Intergovernmental Panel on Climate Change.

Saudi Arabia's generally small environmental and sustainability movement fails to drive consumer pressure on firms to adopt more sustainable and less wasteful practices. In terms of consumer tastes and social norms, it is usually seen as prestigious to have new goods (rather than, for example, second-hand clothing). As discussed above, the social value placed on serving plentiful food to guests has translated into routinely excessive provision of food, much of which is thrown away.

Data

There is a lack of publicly available data on environmental impacts in Saudi Arabia which could incentivise a shift to more circular approaches. Data on waste is patchy, and various studies provide different figures, making it difficult for the government or the private sector to assess the scale of the need – or the opportunities for business. Data on the environmental and ecological cost of current production and consumption methods is also very limited.

4. CIRCULARITY IN ACTION: CHILE, DENMARK AND CHINA

Chile, Denmark and China have attempted to address some of the roadblocks facing Saudi Arabia and could offer valuable lessons as the Kingdom looks to transition to a more holistic circular economy model.

Chile: A resource-dependent economy with a collaborative approach

Like Saudi Arabia, Chile is an emerging economy that relies on unsustainable mineral extraction (copper in this case). It faces similar water and climate change challenges and also has vast hot and dry expanses of land: its Atacama desert is considered the driest place on earth. Recognising these issues, Chile has adopted a circular economy national strategy, centred around creating a collaborative business ecosystem that reduces pressure on natural resources.

In 2019 it announced a national “plastics pact” initiative, becoming the third country in the world to create such a pact. Along with other pact countries, Chile is developing a set of ambitious, time-bound targets for eliminating single-use plastic packaging through redesign and innovation; ensuring that all plastic packaging is re-usable, recyclable, or compostable; increasing the re-use, collection, and recycling of plastic packaging; and increasing recycled content in plastic packaging. To spur ideas for how to meet such targets, Chile opened the Centre for Innovation and Circular Economy in the Atacama desert city of Tarapacá – the first centre of its kind in Latin America.⁷⁸ Each year, the centre hosts an open contest where it invites diverse stakeholders to identify potential circular economy innovations.

Sample policies and activities in priority focus areas

Municipal waste: In 2018, Chile became the first country in Latin America to introduce a law on extended producer responsibility (EPR), which makes the producers of six key categories of goods (including electrical appliances, batteries and tyres) responsible for their products throughout their life cycles. This means that producers are responsible for organising and paying for the recycling or re-use of their products, or for disposing of them as waste. The EPR law has incentivised firms to invest in re-use and recycling, and to reduce waste, for example by adopting biodegradable packaging.

Food waste: In an effort to reduce food waste, La Moneda Palace in Santiago, one of Chile’s most significant government buildings, is now processing food waste onsite.⁷⁹ La Pintana, one of Santiago’s poorest neighbourhoods, has also launched a community food waste initiative,⁸⁰ with the municipality now collecting 140 tonnes of plant waste from homes every week.⁸¹

Municipal recycling: The city of Santiago aims to divert 36,000 tonnes of waste from landfills and has launched key recycling initiatives to meet this target. Alongside new recycling centres in local areas, it has created “clean points” where waste can be sorted in order to be re-used. It has also invested in new equipment and personnel training programmes to enhance the transportation, classification and elimination of illegal waste disposal in public spaces.⁸²

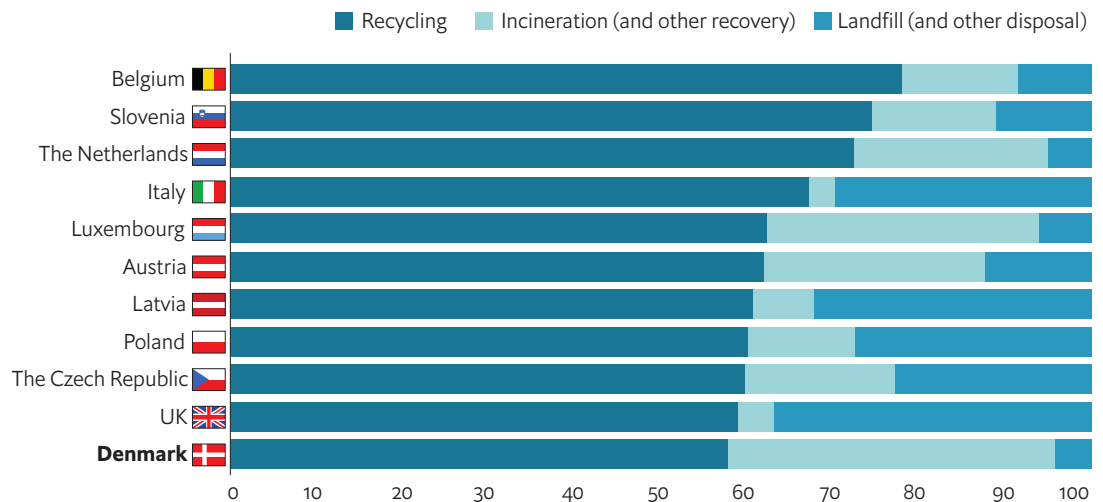
Denmark: Industrial symbiosis and a fresh approach to plastic

Denmark is a small country – Saudi Arabia is 50 times its size – with a rich tradition of developing pioneering circular economy policies. In 2018, the Danish government developed a national circular economy strategy which aims to position the private sector as the driving force in the transition, supported by government funding for innovative product design, waste management initiatives, and data collection.

Danish business has an innovative track record in this regard. The municipality of Kalundborg is widely considered to be a leading example of “industrial symbiosis” in action – where one firm’s waste is turned into another firm’s raw materials. For instance, process steam from a combined heat and power plant is used by an oil refinery and two biotechnology companies, while the same power plant’s ash is used for cement and construction. According to the World Wide Fund for Nature, more than 95% of the power plant’s input water, and more than 98% of the refinery’s input water, is re-used within the Kalundborg industrial symbiosis system.⁸³

Sorting it out

Top EU performers in waste treatment



Source : Government of Denmark (2018)

Sample policies and activities in priority focus areas

Municipal waste: Denmark suffers significantly from plastic waste washing up on its shores and is prioritising the development of a “new plastics economy”.⁸⁴ In December 2018, it introduced a 27-point plan for “plastic without waste”, which includes measures to:⁸⁵

- Halve the consumption of plastic bags by 2023
- Improve recycling rates, with a target for half of all plastic bottles to be recycled by 2025⁸⁶
- Facilitate cross-sector cooperation within the construction, restaurant and agricultural industries.

The Danish island of Bornholm, meanwhile, is aiming to move to a zero-waste economy by 2035.⁸⁷ “Instead of investing in a new incineration facility, we decided to simply eliminate landfill and incineration as waste management options,” stated Jens Hjul-Nielsen, CEO of BOFA, the island’s waste management company and key architect of the waste-free vision. Hjul-Nielsen’s plan is to “reuse or recycle everything” by 2032.

Food waste: Denmark is one of the leading countries in Europe in the battle against food waste – successfully cutting its overall food waste levels by 25% between 2012 and 2017. It has long recognised the issue. In 2008, it launched the “Stop Spild Af Mad” (Stop Wasting Food) campaign, which is credited with spurring an ideological shift on food waste across the country.⁸⁸ In 2016, the Danish Ministry for Food created a subsidy scheme to fund projects that aim to tackle food waste.

Municipal recycling: Denmark has been leading a push to “re-imagine” the typical municipal recycling facility. In Nordhavn, the government established a local recycling centre that was built from 90% upcycled materials in order to raise public awareness that municipal waste can be a resource for construction. Described as an “instructive and social space, which makes the sorting of waste an intuitive and interactive process”,⁸⁹ the facility includes a “swap shelf” and a space that can be used for flea markets to encourage consumers to re-use and recycle their waste. The architect of this initiative, Legandar Group is a leading proponent of the circular economy model and the idea of “designing for disassembly” so that materials can be re-used.

China: The rise of eco-industrial parks

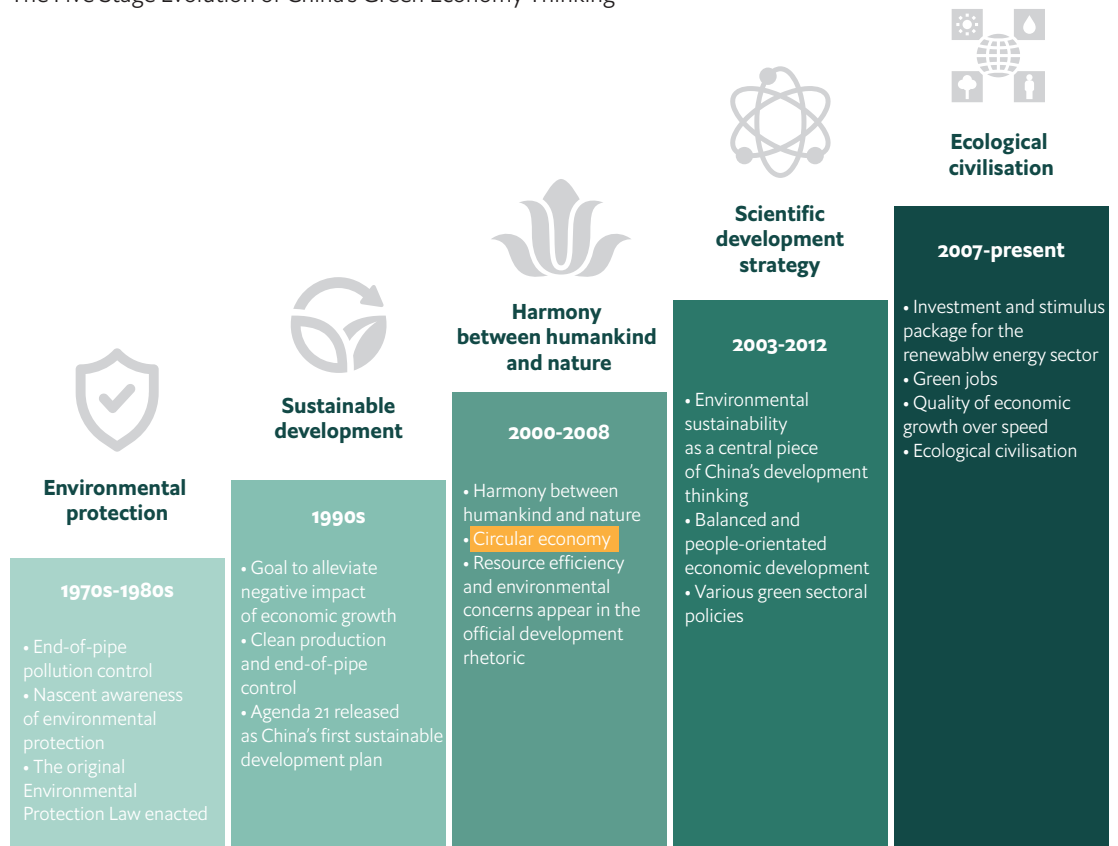
Like Saudi Arabia, China is contending with considerable environmental damage owing to its traditional linear economic model – in this case from its vast industrialisation process. In response, it has been among the early adopters of the circular economy model, which it links to the concept of an “eco-civilisation” based on frugality, environmental protection and sustainability. Developing an eco-civilisation has been a stated aim and priority of the Chinese Communist Party since 2012.

In 2008, China passed a law to promote the circular economy which included support for research and development (R&D) and international cooperation. Five years later, the Circular Economy Development Strategies Action Plan established formal targets and outlined how a circular economy could be developed in China at three levels: within a company, industrial park, and city or region.

Today, China aims to re-use or recycle 50% of waste by 2025. To achieve this, it is aiming to transform existing industrial parks into “eco-industrial” parks where industries work together to recycle and re-use materials, and turn one company’s waste products into inputs that others can use. The Rizhao eco-industrial park is a particular success story, with 98% of its solid industrial waste now recycled through industrial symbiosis.⁹⁰

China's circularity

The Five Stage Evolution of China's Green Economy Thinking



Source: International Institute for Environment and Development (2015)

Sample policies and activities in priority focus areas

Municipal waste: In 2016 China rolled out an Extended Producer Responsibility plan which, for the first time, requires firms to be responsible for the entire life cycle of their products, from product design through to recycling or waste disposal.⁹¹ For instance, it now has a pilot programme in 17 areas for the collection and recycling of electric vehicle (EV) batteries. EV battery manufacturers are responsible for using their after-sales networks to collect batteries for recycling or re-use (the latter can be done through stationary energy storage). The batteries are given individual identification codes so they can be traced throughout their life cycle.

Food waste: A 2018 report estimated that the food thrown away in China each year would be enough to feed 30m–50m people – or the entire population of Saudi Arabia.⁹² In July 2019, Shanghai made it compulsory for consumers to sort their waste, recycling and food waste into separate bins. Alipay and WeChat, the popular payment platforms, have developed apps to identify which bin a particular product or item of packaging should go into, covering some 400 types of solid waste. In addition, other services have emerged which sort consumer waste for a small fee.⁹³

Municipal recycling: Little Yellow Dog, a company promoting sustainability, has rolled out a programme of smart bins through which users can earn money for recycling.⁹⁴ It has 2.6m users and operates more than 10,000 smart bins in 33 cities. The bins automatically identify the type of waste that is being recycled, using cameras and measuring weight and density, and then pay users if they are found to have recycled metals, plastic or cardboard boxes. The bins also automatically alert collection services once they are 80% full. John Kalogeras of Hewlett Packard notes that Saudi Arabia could improve waste collection patterns by adopting similar technologies, and that “Garbage pick-up vehicles can take the shortest route, because the rubbish bins themselves indicate when they need emptying.”

5. POLICY TOOLKIT

Transforming Saudi Arabia from a linear to a circular economy is a generational shift that will require committed and sustained involvement from diverse stakeholders. As a starting point, policymakers must create a holistic, enabling environment for businesses and individuals to lead on the transition towards a circular economy model. Below, we outline a selection of potential focus areas, policies and actions, based on the gaps that Saudi Arabia faces and evidence on what has worked well internationally.

A. Provide national circular economy leadership

1. Design a circular economy strategy

A circular economy captures a diverse range of activities by a diverse range of stakeholders. A national strategy could provide Saudi Arabia's nascent circular economy with *focus, prioritisation* and *buy-in*. It could also provide clearly defined KPIs and an explicit division of labour between government entities.

For the strategy to be successful, it must be linked to prominent existing strategies, notably Vision 2030, the NTP and the national environment strategy. Targets should be in sync with the sustainability goals outlined by the national "Quality of Life" programme (a Vision 2030 initiative which aims to improve lives through enhancing culture, sports and the environment),⁹⁵ as well as individual city and municipality authorities.

The strategy should set short-, medium- and long-term goals. It should prioritise areas where short-term impact is viable, such as in recycling. But longer-term goals must include shifting the country's oil sector towards a more circular model – for instance, by using oil to create goods that last longer. The petrochemicals and plastics industries, spearheaded by SABIC, are already applying circular economy concepts to their operations, and the aluminium sector also has a significant role to play.

- International example: In 2016, the Dutch government published a comprehensive circular economy strategy that committed to hard targets to halve its use of raw materials by 2030 and to become "fully circular" by 2050.⁹⁶

2. Dedicate funds to support circular economy efforts

Shifting Saudi Arabia's economy from a linear to a circular model will be difficult as it will challenge the fundamental assumptions and behaviours that have underpinned economic growth for more than 30 years. Some established stakeholders could also lose out from the shift. As a result, a new circular economy strategy could meet with scepticism, as has been the case in some other countries.

To demonstrate that it is genuinely committed to shifting to a circular economy, the government should consider backing its strategy with dedicated and substantial financial resources. These resources could be used to subsidise and stimulate industry activity, particularly in more innovative areas.

- International example: Zero Waste Scotland is a dedicated government fund for circular SMEs and start-ups, helping to "de-risk", or reduce the risks faced by their nascent business models.⁹⁷

B. Incentivise circularity among firms and consumers

1. Prioritise new fiscal incentives

Saudi policymakers should explore incentive programmes that reward firms for developing products and services based on re-use, repair, remanufacturing and recycling, and reward consumers for recycling and using more efficient equipment (while penalising those who do not). A vast range of incentives could be considered – from supportive solar panel subsidies to punitive plastic bag or waste charges.

As with any new incentive programme, the government should work with the private sector and civil society to first prioritise potential programmes and to study their likely economic and social impact, prior to implementation, given the risk of unintended consequences. For example, while the evidence to support plastic bag levies is robust, it is not without its challenges – in some countries, levies have reduced the use of plastic bags primarily among people who were already using re-usable bags to a certain extent, with little effect on others. Those who already use re-usable bags tend to be from a higher socioeconomic background, leading to concerns that levies may be regressive.

Similarly, there is robust evidence to support waste taxes that tackle externalities by making individuals pay a fixed fee for the number of bags of waste produced. However, they are often unpopular, especially if their introduction is not accompanied by a well-designed communication programme and tools to minimise waste. Although wealthier households tend to produce more waste, waste taxes can still be regressive, so efforts should be made to offset the economic effects on lower-income households. For example, revenue raised from the tax can be used to provide free, or subsidised, municipal recycling facilities.

- International example: China's old-for-new home appliance replacement scheme, introduced in 2009, provides consumers with a subsidy of 10% of the cost of buying a replacement if they ensure that their old appliance is recycled by a recognised recycler. To combat smog in its cities, China has also introduced a comprehensive subsidy programme for electric and hybrid vehicles. Although the programme has led to some abuses, and has been adapted, it has dramatically boosted the uptake of EVs.⁹⁸
- International example: In Vaud, a region in Switzerland, a refuse tax reduced household waste by 40%, and increased recycling of aluminium and organic waste.⁹⁹

2. Trial green and circular public procurement programmes

Globally, governments are major buyers of goods and services: public procurement in the EU reached almost €2trn in 2016, or 13.4% of the bloc's GDP.¹⁰⁰ In Saudi Arabia, government expenditure is far higher – reaching 35% of GDP in 2018 – owing to the public sector's dominant role in the economy.¹⁰¹ Supporters of green procurement argue that, when selecting suppliers, government entities should incorporate "circular" criteria into their traditional cost-benefit analysis. In doing so, governments can also act as a "lead buyer" for innovative products that are not yet commercially viable. While applying such criteria to all public procurement will take time, Saudi Arabia could consider trialling them among specific departments or for specific types of purchases.

International example: The Netherlands has implemented pilots for circular procurement of certain goods and services (such as IT equipment and office furniture) in the public sector, and has established a Circular Procurement Academy for public-sector organisations to share experiences and best practice.¹⁰²

C. Monitor circular behaviour and track progress

1. Create a framework to monitor national circularity

At present there is a lack of data on circular economy outcomes in Saudi Arabia, nationally and at the regional and industry levels. This makes it challenging to assess overall awareness and uptake, and to prioritise areas of focus and set realistic targets. In recent years, a growing number of countries have developed circular economy measurement tools and methodologies which Saudi Arabia can use to develop its own localised framework. Once developed, the data should be made publicly available to assist academics, the private sector and the wider civil society in assessing circular economy opportunities.

- International example: France developed ten overarching indicators to monitor the circularity of its economy across seven pillars: recycling (materials and organic matter); sustainable supply chains; eco-design of products and procedures; the functional economy; industrial and territorial ecology; responsible consumption (purchasing, collective consumption and use); and extending product lifespan (re-use, repair and recycle).¹⁰³
- International example: Spain applied the “Cotec Evaluation” model, which includes 20 indicators across five categories: input material; ecodesign; use of materials in production; use of materials in consumption; and waste recycling.¹⁰⁴
- International example: In January 2018, the European Commission adopted a framework to complement these member state efforts. It includes ten indicators across four “stages” of the circular economy: production and consumption; waste management; secondary raw materials; and competitiveness and innovation.

2. Provide businesses with a tool to assess their circularity

Alongside national-level assessments, Saudi Arabia should empower businesses to measure their own circularity by providing a tool that can be used across sectors and different types of business – from micro-enterprises to large conglomerates. Such assessments could empower businesses to identify priority areas and set targets for how to improve.

- International example: The University of Cambridge Circular Economy Toolkit is a self-assessment tool for businesses to measure their product design and business models for circularity.¹⁰⁵

D. Build in-country capacity for innovation and localised solutions

1. Provide dedicated funding for circular R&D

R&D can help to create innovative localised circular economy products and services in Saudi Arabia. Rather than starting from scratch, Saudi Arabia should look to build on existing strengths and centres of excellence, such as the research on renewable energy and sustainable food at King Abdullah University of Science and Technology, which could then be expanded into dedicated circular

economy university centres. To convert R&D funding into practical applications, university centres should look to evolve into “innovation centres” that partner with leading private-sector players to test innovative business models and product designs.

- International example: The EU’s “Horizon 2020” research and innovation programme allocated a dedicated budget of €650m (US\$725m) for circular economy research.¹⁰⁶
- International example: Alongside Chile’s Centre for Innovation and Circular Economy in Tarapacá, Taiwan has created the Institute of Innovation and Circular Economy at Asia University.

2. Collaborate with international universities and research centres

Setting up dedicated R&D centres is a major undertaking that typically requires a deep pool of local research talent and strong corporate partners. In the short term, Saudi Arabia should consider as a first step establishing partnerships with existing circular economy research centres and funding research programmes at these centres. It could include circular economy study programmes among the priority subjects in which the government funds scholarships for international study.

- International example: The Ellen MacArthur Foundation has developed a network of universities that engage in circular economy teaching and research. There is a strong culture of collaboration among these universities, both with respect to knowledge exchange and practical collaboration, and new projects and initiatives.¹⁰⁷

3. Create a forum for industry–government–academia–civil society collaboration

Effective circular economy innovation rests on regular, sustained and symbiotic industry–government–academia–civil society collaboration. To spur such collaboration, government agencies in Saudi Arabia should help to create coalitions and networks with leading businesses, NGOs and academic institutions. For example, as a starting point, a new forum could share best practices on how to maximise the value of raw materials and facilitate the adoption of sustainable production methods – a critical objective for Saudi Arabia today – and instigate discussions about how to kickstart industrial symbiosis models.

- International example: The UAE government formed a circular economy coalition with NGOs, multinationals and local private companies, with an initial focus on tackling waste and packaging pollution.¹⁰⁸

E. Develop public environmental awareness and ecological literacy

1. Design a new environmental educational programme for Saudi schools

As elsewhere, Saudi youth form attitudes and values towards the environment at an early age, making comprehensive environmental education crucial. Beyond imparting knowledge, this education should help to develop pro-environmental attitudes, responsibility and ethics among Saudi youth. Some examples are already visible, such as the Dhahran Ahliyya School, which has established ecology as a key educational theme.

Rather than ad hoc initiatives, policymakers could design a holistic environmental education programme to be introduced into public schools’ curricula. The programme should be tailored to Saudi Arabia’s unique environment, but leverage best practices from the readily available reviews of international environmental education programmes. These reviews highlight key components, such

as the need to foster genuine connections with the natural world through field trips, for example; the need to link education to students' everyday lives; and the role of technology in bringing environmental challenges to life.

- International example: In La Quinta, California, schools partner with local land management bureaus to carry out desert clean-ups, and analyse the effects of illegal dumping on the desert environment. Schools in the US have also provided students with carbon dioxide monitoring devices to quantify the levels of the gas on their school journeys. At school, students visualise the data using Google Earth, and analyse why emissions are higher in some locations than others.¹⁰⁹

2. Support environmental volunteering and citizen science

Outside of formal education, all Saudis need more opportunities to develop a deeper understanding of their environment, and ultimately become environmental “protectors” as opposed to passive “consumers”. Volunteering activities tend to be concentrated in major cities, and led by wealthy, well-educated members of the population. A new nationwide volunteering programme, focused on key circular economy activities, would open up volunteering to citizens across the country.

In a similar vein, “citizen science” describes initiatives where members of the public collect and analyse data relating to the natural environment, typically in collaboration with professional scientists. Its development is part of a wider trend of crowdsourcing, which sees governments and other organisations appealing to mass public engagement to help with their work. As with environmental volunteering, citizen science would help to develop Saudis' natural interest in, and awareness of, the environment, which could encourage them to pursue more circular activities.

- International example: The Scuba Tourism for the Environment programme is led by Egypt's Ministry of Tourism, the Italian Ministry of Environment and a series of private-sector partners (Saudi Arabia has also had some involvement). The volunteer-based programme monitors the status of coral reefs in three Red Sea countries: Egypt, Sudan and Saudi Arabia. The volunteers are recreational divers and are asked to fill out a simple questionnaire about what they see during each dive.

3. Revise food storage guidelines

While food recycling is possible, it is considerably easier and more environmentally friendly to simply reduce the amount of food being wasted. Saudi policymakers can first re-examine food labels in stores, particularly ambiguous “sell by” and “display until” labels, which are often misunderstood by consumers, and lead to food being disposed of while still perfectly healthy for consumption. In addition, policymakers can partner with food companies to educate Saudi consumers about what these dates mean and to provide them with guidance on how to store fruit and vegetables so that they last longer.

- International example: In the UK, a food storage awareness campaign, led by the government-backed charity WRAP, contributed to a 15% reduction in food waste between 2007 and 2012, saving every household in the country an average of £130 per year.¹¹⁰

F. Lead regional circular economy collaboration

1. Collaborate with neighbouring GCC countries:

By leveraging its strategic geographic position, Saudi Arabia has the potential to become the region's centre for circular economy leadership. Specific measures that can be taken include organising regional conferences on the circular economy, including in the run-up to the G20 meeting in 2020, as well as working towards GCC-wide standards, certification or harmonised product information systems in specific sectors and value chains, such as appliances, furniture and vehicles. This could potentially start as a voluntary collaboration between private-sector firms from interested countries.

- International example: The OECD organised its first Roundtable on the Circular Economy in Cities and Regions in July 2019.¹¹¹ The event served as a hub for governments, cities and regions from around the world to understand and share knowledge on the transition to the circular economy.

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