



الهيئة الملكية لمدينة الرياض
ROYAL COMMISSION FOR RIYADH CITY



Riyadh Environmental & Sustainability

أطلق سمو ولي العهد رئيس مجلس إدارة الهيئة الملكية لمدينة الرياض نائب رئيس مجلس الوزراء، استراتيجية الرياض للاستدامة في منتدى السعودية الخضراء بتاريخ 23 أكتوبر 2021م وتضمنت الاستراتيجية خمس مرتكزات رئيسية وهي تطبيق مفهوم الإقتصاد الدائري الكربوني، والإستغلال الأمثل للموارد الطبيعية وإعادة استخدامها، والتحول نحو الطاقة المتجددة، وزيادة التشجير والمحافظة على الموارد والمناطق الطبيعية، وتشجيع التنمية الاقتصادية بطرق مستدامة.

وشملت الاستراتيجية (50) مبادرة موزعة على خمس محاور، وهي الطاقة المتجددة والتغير المناخي، وجودة الهواء، وإدارة موارد المياه، وإدارة النفايات، والتنوع البيولوجي والمناطق الطبيعية، بحيث ينبثق من المبادرات عدد من البرامج والمشاريع النوعية.





We must create the conditions for a more sustainable economy. We have therefore promoted the principle of a circular carbon economy as an effective approach to achieve our climate change goals and ensure cleaner, more sustainable and affordable energy systems

King Salman Bin Abdulaziz
Custodian of the Two Holy Mosques

G20 Summit
November 2020



We aim to transform Riyadh into one of the most sustainable cities in the world

HRH Mohammed bin Salman bin Abdulaziz,
Crown Prince, Deputy Prime Minister, and the
Chairman of the Royal Commission for Riyadh
City

Saudi Green
Initiative Forum
October 2021

If Riyadh Invests in Sustainability now, there is Potential for Significant Economic and Wellbeing Advantages



ECONOMY



SAR 125-150 Bn

increase in Riyadh's GDP by 2030
(4-5% of total)



~300-350k

new jobs created by 2030
(~3-4% of total jobs)



LIVES and LIVABILITY



15-20

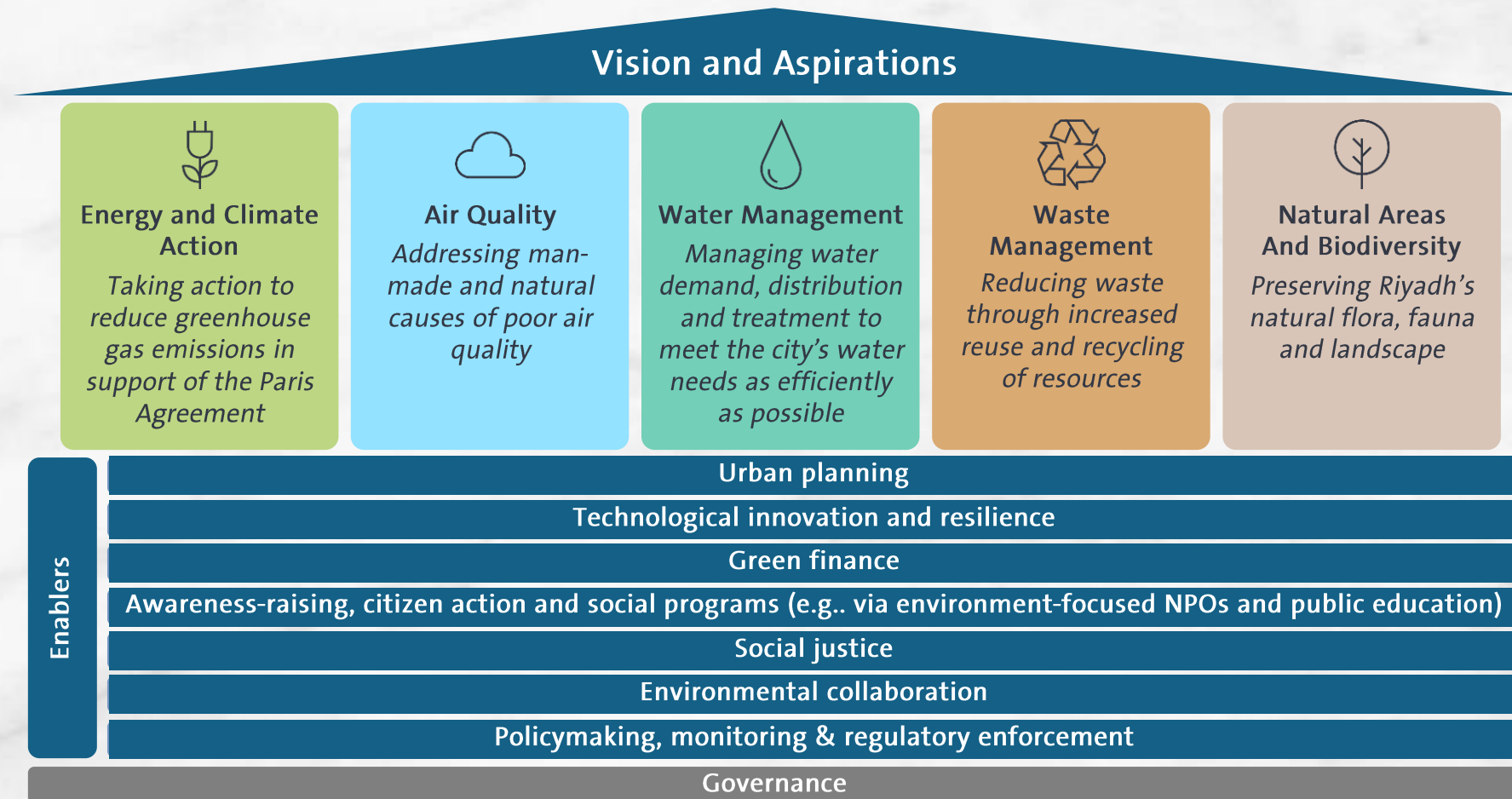
positions rise in livability
ranking¹



>15k

annual deaths avoided

**An Aspirational
Environmental
Sustainability
Program Could
Generate
Significant
Benefits for
Riyadh and its
Citizens**





Position Riyadh as a responsible global leader in sustainable development that can raise the aspirations of other cities

Recognise the responsibility that the people of Riyadh bear to preserve and enhance the city's natural environment for future generations

A global steward of Environmental Preservation and a global Economic Engine driven by Resource Conservation

Highlight the transformation that Riyadh will undergo as it doubles its population by 2030

Set conservation and efficiency as the main theme for Riyadh's environmental plan – based on an Arabic value of avoiding wastefulness





Targets for 2030 Aspirational Scenario

Energy and Climate Action	Air Quality	Water Management	Waste Management	Natural Areas and Biodiversity
A city that pioneers green energy 50% share of renewables 50% reduction from BAU carbon emission	A city that prioritizes clean air 30% reduction in NO₂ levels to achieve compliance with WHO guidelines	A city that does not tolerate water leakage Pioneer smart water piping to reduce leakage to global best practice of 8%	A city that strives to be circular 90% diversion of MSW waste from landfill; Elimination of illegal dumping	A city that wants to build its green lungs Planting of 15 Mn¹ trees - largest urban greening programs globally
A city that embraces new mobility 30% EV adoption, 30-45%² of all trips are non-car based	A city that learns to adapt Adaptation as way of life: 100 smart trees throughout Riyadh to reduce particulate matter	A city that reuses every last drop Treat and reuse 100% of all waste water the city generates	A city that champions sustainable construction Target the global best practice recycling rates of 80% for all construction waste	A city that preserves nature at its finest 22%³ Green space in the urban limits and 150% reserves area VS Riyadh urban limits

1. Planting 15 Mn trees from recycled wastewater would require ~2 Mn m³ per day, ~70% of total recyclable wastewater in 2030 (133 litres per tree as per Green Riyadh). Alternatively, RCRC could increase network, plantation and watering efficiency to reach the global watering per tree average (~65 liters/day) and still be able to plant 15 Mn trees with only 1 Mn m³ per day
2. In line with Riyadh Strategy's target
3. 22% is the overall area designated for future greening space, while 2030 target is 9%



1

Energy and Climate Action



1. Energy and Climate Action – Targets and KPIs



Aspiration

To achieve net zero carbon emissions by 2050 and deliver the largest decarbonisation of any megacity

KPI	2030 target
Reduction of carbon emissions from BAU, %	45-55%
Carbon emissions per capita, MtCO ₂ /person	6
Electricity consumption per capita, MWh/person/year	5
% energy from renewable sources of total energy use, %	50%
% journeys made walking, cycling or taking public transport	30-45%
% Electric vehicles or hybrids of total new cars in the urban area	30%

Source: Riyadh City Strategy, Urban Observatory, city Environmental Sustainability Strategy

1. Energy and Climate Action – Initiatives (1/2)



NOT EXHAUSTIVE

☆ Game-changer

Detailed next

Area	Why it matters	Key Initiatives (new initiatives in bold)	
Energy	Producing electricity from fossil fuels contributes ~50% of all carbon emissions	Develop large scale solar and hydrogen power generation plants (first pilot at NEOM)	
		Rationalize electricity prices, introduce peak pricing for residential and/or non residential use to encourage efficient usage	
		Establish a retrofitting programme for existing buildings to encourage demand reduction (e.g.. smart meters, insulation, energy efficient ACs)	☆
		Mandate all new buildings to be zero emission, with low carbon procurement standards	20+ other initiatives identified
		Mandate all government and municipality entities to adapt carbon neutrality plans in their buildings and assets (e.g.. mandating higher temperatures, adapting EVs)	
		Regulate efficient practice in energy production in fossil fuel plants	☆ 4+ national and Riyadh-specific plans and strategies developed
Mobility	Mobility (cars, vans, trucks) account for a quarter of all carbon emissions	Upgrade Riyadh's electricity grid to be 100% smart – define feed-in tariffs to incentivize Riyadh's citizens to generate local decentralized electricity	
		Transition public transport to zero emission (electric/hydrogen buses, renewable energy metro)	
		Incentivise adoption of electric vehicles (e.g.. set progressively high fuel standards for cars, heavy duty vehicles, as free parking for electric, 'Drive clean rebate', free charging)	
		Establish charging infrastructure for electric vehicles (e.g. network of solar carports)	

1. Energy and Climate Action – Initiatives (2/2)



Game-changer



Detailed next

NOT EXHAUSTIVE

Area	Why it matters	Key Initiatives (new initiatives in bold)	
Mobility	Mobility (cars, vans, trucks) account for a quarter of all carbon emissions	Minimize short distance car trips through last mile initiatives (e.g.. new short-distance electric shuttles, bike and e-scooter sharing)	
		Align new district masterplans with best practices of transit oriented development (e.g.., placing residential close to existing metro/bus station)	
Industry	Industry energy usage is set increase as Riyadh grows its GDP ~4x by 2030	Develop a strong Riyadh Standard for Construction to reduce emissions (e.g.. electric generators instead diesel, use of low carbon materials)	
		Pilot carbon sequestration in point sources of high carbon dioxide emission for use in building materials, chemicals, etc.	
Other	Other sources such as agriculture, waste can account for ~5% of all emissions	Incentivise modernisation of industrial equipment within Riyadh to reduce emission	
		Monitor and track and reduce GHG emissions from waste and agriculture processes	
		Develop and implementation climate change adaptation plan specific to Riyadh on urban heat islands and increased dust storms (e.g.., Green Riyadh, vertical farming)	

20+
other initiatives identified

4+
national and Riyadh-specific plans and strategies developed

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نراقب جودة الهواء من أجل بيئة أفضل
Monitoring Air to Improve the Environment

2

Air Quality



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2. Air Quality – Targets and KPIs



Aspiration

Drive holistic improvement of Air Quality while experiencing one of the fastest growth of a city

Based on Ambient Air Quality Annual Report 2018

Riyadh

KPI

2030 target

Annual average PM₁₀
concentration in air,
µg/cubic meter

120

Annual average PM_{2.5}
concentration in air,
µg/cubic meter

40

Average annual
nitrogen dioxide
concentration in air,
ppb⁴

21



2. Air Quality – initiatives



NOT EXHAUSTIVE

☆ Game-changer

Detailed next

Area	Why it matters	Key Initiatives (new initiatives in bold)	
Air Quality Monitoring	Empowers vulnerable populations to take action to protect themselves	Air quality monitoring network to grow with city expansion, with real-time alerts to citizens at times of high pollution through social media, as well as air quality forecasting	
		Monitor and set targets for highly carcinogenic Benzene as well as Ozone	
Particulate Reduction (PM2.5, PM10)		Use PM reduction methodologies and policy interventions for vulnerable/high pollution neighbourhoods (e.g.. air purifier towers, smart trees, curfews for high PM days)	☆
		Pilot micro mobility systems (e.g.. electric scooters) to achieve last mile integration with public transportation systems	
		Develop congestion charge zone in central Riyadh and implement emission-based road parking charges	☆
		Launch multi-modal trip planning by integrating metro and bus systems	
Nitrogen Dioxide Reduction	Contributes to respiratory diseases	Shift from normal internal combustion engine vehicles (ICEVs) to hybrid electric vehicles (HEVs) and electric vehicles (EV) by at least 30% of the passenger vehicles fleet	
		Develop a strong Riyadh Standard for Construction to reduce pollution (e.g.. spray water on debris before dumping, using dust screens)	☆
		Implement strict international air pollution guidelines (e.g.. WHO) for point sources of air pollution sources such as industrial zones (KSIZ), power stations (e.g.. electrostatic precipitators), quarries	

20+
other initiatives
identified

4+
national and Riyadh-
specific plans and
strategies developed

Source: RCRC

2. Air Quality – Potential new initiative: local air purifying solutions

Smart trees

Locality focused

Overview

Smart trees are freestanding, vertical units are covered in moss and lichens which have a massive surface area to **absorb particulate matter, nitrogen dioxide and ozone**

Impact

A single smart tree has an environmental benefits of **275 urban trees**

Cost

Each smart tree can cost
~SAR 95k

CityTree
by Green City Solutions

Air purifying towers

Neighbourhood focused

Overview

Air purifier towers (or 'SMOG towers')
use technology to scrub air of particulate matter of all sizes, and are run on small amount of solar energy

Impact

A single 100m tower is capable of improving air quality over an area of 10 square km (**1.3x size of King Salman Park**)

Cost

Each 100m tower can cost
~SAR 1-2 Mn

Experimental Smog tower
built in Xian, China



3

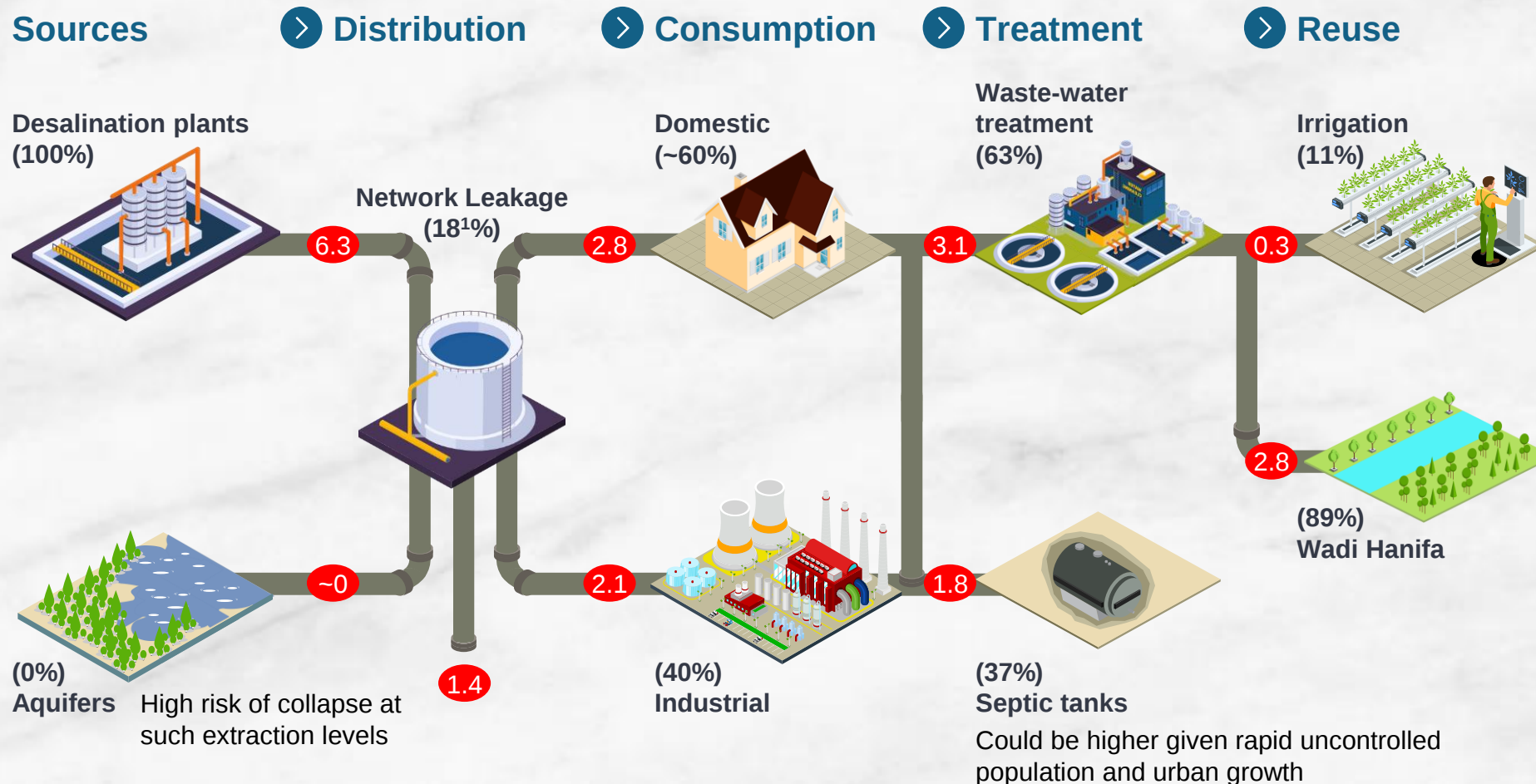
Water Management



3. ...with Issues Expected to be Further exacerbated under a 'Business-as-usual' scenario

Daily water flow for Riyadh in 2030, 'Business-as-usual' scenario

● Million m³ of water/day, 2030



Key takeaways:

- Riyadh will need to 3x production from both desalination and aquifers to meet projected 2030 demand
- Network leakage will reach around 2.8 Mn m³ in 2030, the equivalent of all current water production for Riyadh

1. Assuming leakage in new development will be drive the percentage from 36% to 18%

3. Water Management – Targets and KPIs



Aspiration

To be globally leading water sensitive city by reducing consumption and reusing 100% of the city's wastewater by 2030

KPI	2030 target
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Resilient water supply, % water from desalination	95-100
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Water distribution losses, %	8 ²
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Potable water consumption, litres/person/ day	150 ³
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Sewage network coverage, %	95-100
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Wastewater recycling, %	90- 100 ⁴
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3. Water Management – initiatives (1/2)



NOT EXHAUSTIVE

☆ Game-changer

Detailed next

Waste type	Why it matters	Initiatives (new initiatives in bold)	
Production	Ensuring water supply keeps up with rapid increase in demand	Regularly monitor extraction volume and quality of aquifer and promote avenues for regeneration	
		Increase the number of rain capture tanks/dams and other renewable groundwater resources, including examining the usage of shallow groundwater/aquifers	
		Incentivize practices to reduce agricultural consumption and monitor agriculture aquifer usage (e.g., drip irrigation and hydroponics)	☆
		Add ~1-1.5 Mn m ³ desalination capacity for Riyadh by 2030 and enhance reservoir capacity to account for 7 days of storage space	☆
Distribution and treatment	Big opportunity to reduce water demand through leakage reduction and reuse	Adapt water sensitive urban design (WSUD) approach to design all new urban developments and existing developments if whenever possible	
		Connect 95-100% of Riyadh population to sewage network, and mandate all new developments to connect with the overall city network	☆
		Deploy smart digital solution to detect leaky pipelines to upgrade as well as for predictive maintenance	☆
		Build ~2-2.5 Mn m ³ of waste water treatment plants by 2030	☆
		Build small recycling stations for grey water in mosques, governmental buildings and public facilities and use it for irrigating surrounding greenery	
		Build a network of pipes to carry grey water for intended end uses (e.g., Green Riyadh)	

60+
other
initiatives
identified

8+
national and
Riyadh-
specific plans
and strategies
developed

3. Water Management – Initiatives (2/2)



NOT EXHAUSTIVE

☆ Game-changer Detailed next

Waste type	Why it matters	Initiatives (new initiatives in bold)	
Consumption	Riyadh has amongst the highest water consumption per capita	Employ behavioural (e.g., community competitions), market based (e.g., peak pricing) and technological (e.g., smart water meters) to reduce consumption Mandate that all new buildings incorporate recycling stations and smart water metrics on site (LEED platinum standard] for internal reuse Roll out water efficiency labelling scheme on appliances and fittings to encourage consumers to buy water efficient products Mandate all companies/industries to implement water conservation practices and monitor their implementation by installing smart consumption meters that RCRC can have remote access to	☆ ☆

3. Water Management – Potential new Initiative: Smart Leakage Detection and Control

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Overview

Remote **monitoring of water pipe conditions** using leakage sensors

Control of water pump pressure to **reduce/prevent water leakage**

Early identification of leakage to prompt follow up actions from maintenance team

Identifies leaks **without excavation**

Impact

Could result in **water leakage reduction by 50%¹**

Cost

SAR >4 Mn for sensors and controllers

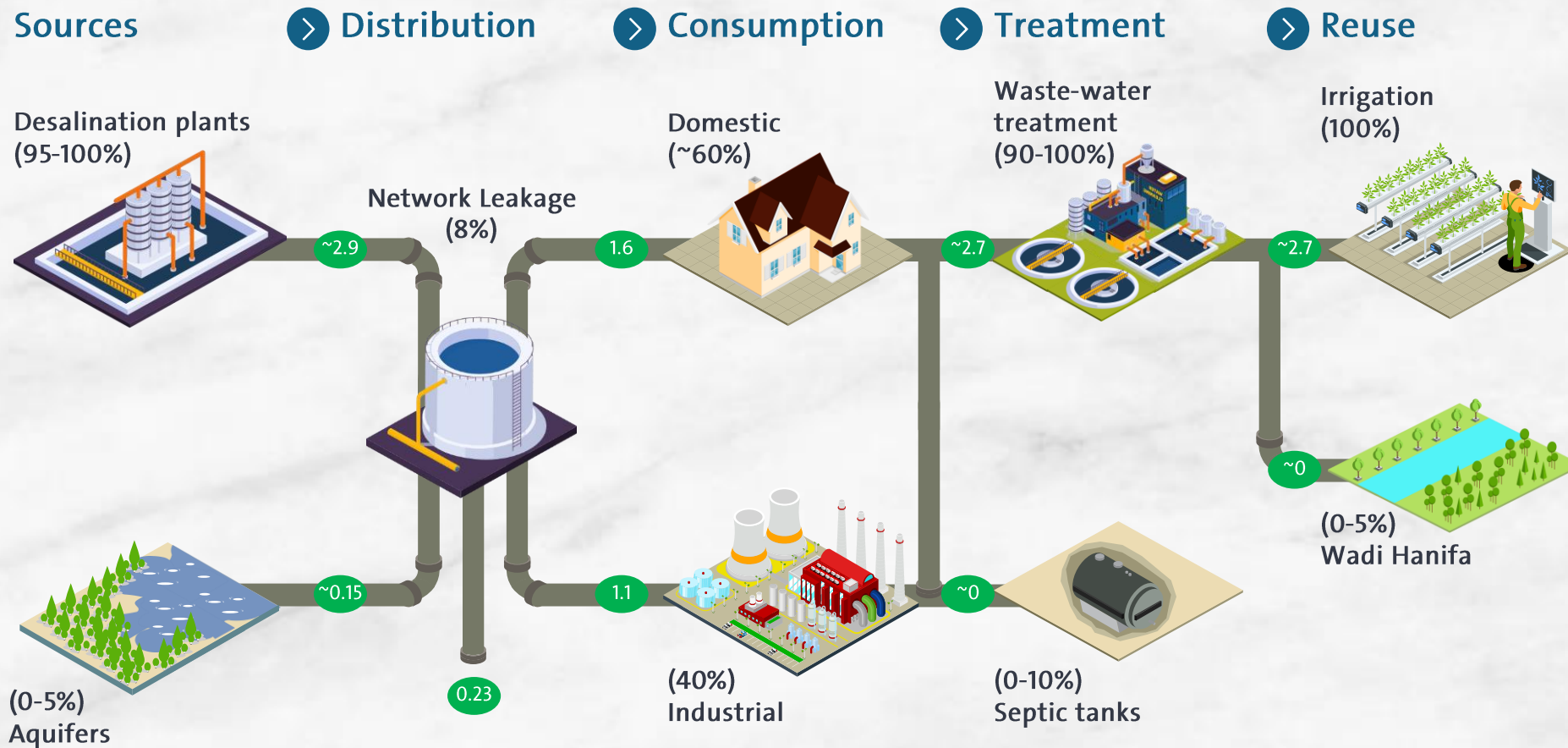
~SAR 20 Mn for 5 years for data analysis and operation

1. Based on the results pulled from implementing the same solutions from Mumbai, India and Malang city, Indonesia

3. Water Management – ‘aspirational scenario’ summary

Daily water flow for Riyadh in 2030, ‘aspirational scenario’

● Million m³ of Water/day, 2030, aspirational scenario



Key Takeaways:

- With increasing water efficiency across the value chain, Riyadh will only need to ~2x production from desalination plants to meet projected 2030 demand, while phasing out aquifers



4

Waste Management



4. Riyadh has a sub-optimal Waste Management and Recycling system...



Aspiration

Develop best practice waste management system across all categories with a goal to become regional hub for C&D recycling industry and achieve near-zero MSW waste to landfill by 2030

KPI	2030 target
C&D recovery rate ¹ , %	80
MSW production, kg/person/day	1.2
MSW organic waste, kg/person/day	0.42
MSW sorting at source, %	90
MSW landfill diversion rate, % of total MSW produced	90
C&I illegal dumping, % of C&I not properly treated	~0

25

1. Includes recycling and reuse

Source: Riyadh City Strategy, Urban Observatory, city environmental sustainability Strategy, European Commission, towardszerowaste.gov.sg,

4. Waste Management – Initiatives (1/2)



NOT EXHAUSTIVE

☆ Game-changer

Detailed next

Waste type	Why it matters	Initiatives (new initiatives in bold)	
Construction and demolition waste (C&D)	Accounts for ~90% of waste in Riyadh and majority of visual pollution through illegal dumping	Mandate to sort construction waste on-site in preparation for reuse and recycling and mandate the usage of GPS monitors on trucks to track illegal dumping	☆
		Work with PIF to expand the capacity of the newly developed recycling facility and engineered landfill to reach ~65-75 Mt of C&D wastes	
Municipal solid waste (MSW)	Big opportunity to raise recycling rate from current low level of 9%	Mandate/incentivise the use of recyclates in public works projects (e.g., recycled aggregates in road construction)	☆ 70+ other initiatives identified
		Mandate manufacturers and businesses to use recyclable materials and reduce the usage of Plastic packaging	☆
		Work with farmers, food manufacturers, restaurants and logistic companies to minimize losses in food chain	7+ national and Riyadh-specific plans and strategies developed
		Roll out awareness campaigns and incentivise behavioural shifts (e.g., dumping less food) to encourage people to adapt more recycling friendly behaviours	☆
		Mandate sorting scheme for municipal waste, separated into at least three waste streams (organic waste, recyclables (e.g., paper, cardboard, plastic, glass, metal) and other	
		Activate and support food distribution programs (e.g., Saudi Food Bank 'إطعام') to reduce waste, and mandate restaurants to participate	
		Set up recycling centres to receive large equipment (e.g., appliances)	

4. Waste Management – initiatives (2/2)



NOT EXHAUSTIVE

☆ Game-changer

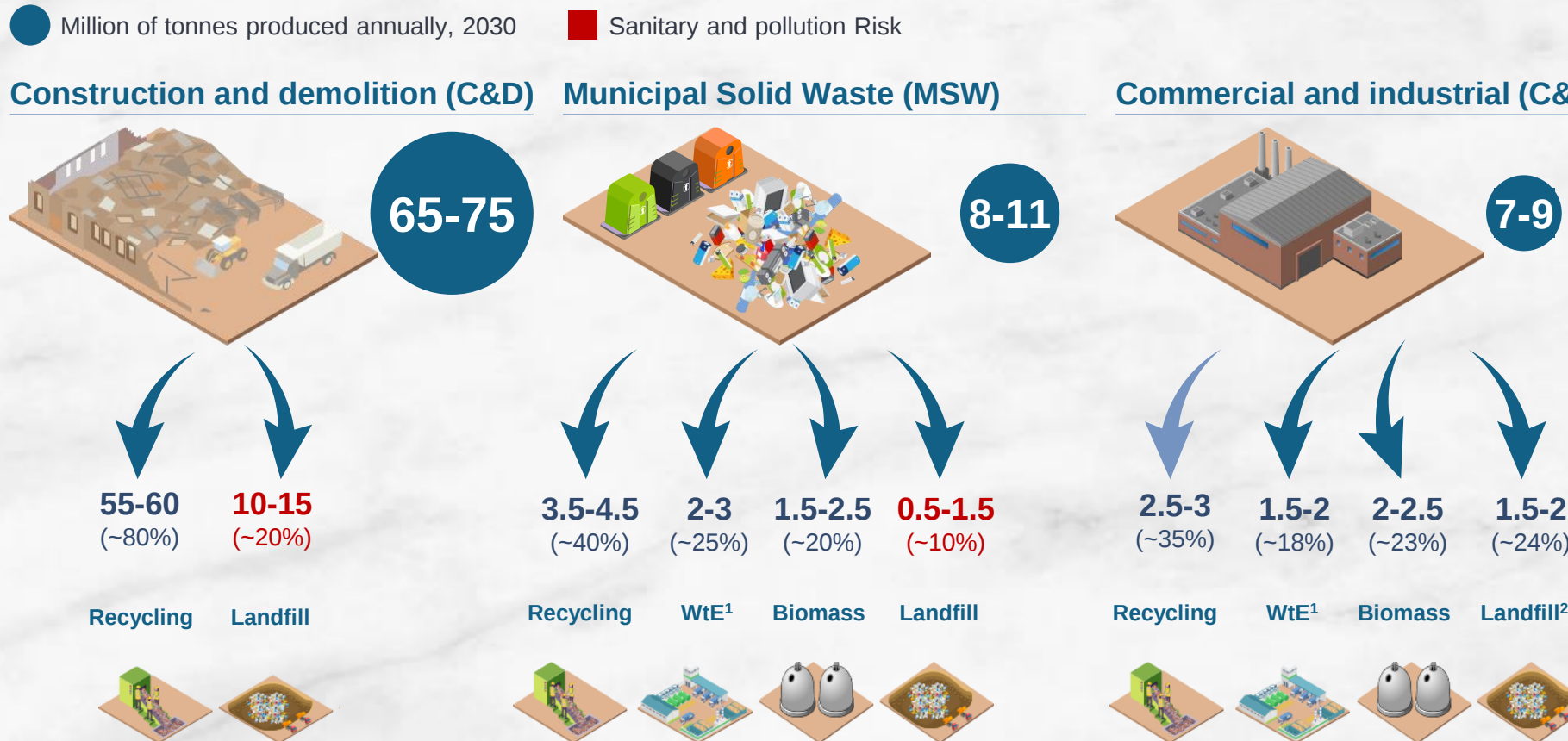
Detailed next

Waste type	Why it matters	Initiatives (new initiatives in bold)	
Municipal solid waste (MSW)		☆ Develop the necessary MSW treatment infrastructure with the projected capacity for 2030 – Material Recovery Facility to process recyclates (4-6 Mt); Anaerobic Digestion and Composting Facility to process organic waste (3-4 Mt); and Energy from Waste to process residuals (3-5 Mt) Create a industry for production of goods from recycled materials (e.g., glass, plastic, e-waste)	70+ other initiatives identified
Commercial and industrial (C&I)	Illegal dumping of hazardous waste is polluting terrestrial ecosystems	☆ Mandate all hazardous waste producers to have a contract with a certified industrial waste collector ☆ Adopt remote geospatial monitoring technologies to detect illegal dumping ☆ Development of specialist recycling capacity for industrial and hazardous wastes and wastewater (0.5-1.5 Mt), including converting electronic waste to raw material Ensure sufficient capacity for incineration of hazardous waste (including bio-hazardous healthcare waste)	7+ national and Riyadh-specific plans and strategies developed

Source: RCRC

4. Waste Management – ‘aspirational scenario’ summary

Annual waste flow for Riyadh in 2030 (aspirational scenario), Mt (%)



Key takeaways

Riyadh is already building adequate capacity for Waste to Energy, but needs to **ramp up its recycling and organic waste processing capacity**

Illegal dumping will be removed with the ‘aspirational scenario’

1. Waste to Energy
2. Proper treatment process is carried out before landfill

Source: RCRC Env Dept



5

Natural Areas and Biodiversity



5. Natural Areas and Biodiversity - Targets and KPIs



Aspiration

Preserve and augment the terrestrial ecosystem and biodiversity for Riyadh while undergoing the development and expansion of the city

Riyadh

KPI

2030 target

Percentage of natural reserves out of the total city and surroundings area, %

60%

Green space share of urban area, %

9%

Green space per capita in urban area, m²/person

28³

of species of flora and fauna (plants and animals) lost in Riyadh

-

0

5. Natural Areas and Biodiversity – initiatives



NOT EXHAUSTIVE

☆ Game-changer

Detailed next

Area	Why it matters	Initiatives (new initiatives in bold)
Nature preservation	Prevents encroachment of urban areas on local biodiversity to create untouched, natural reserves	Inventory and monitor ecologically sensitive areas and prevent development on key sites of natural importance Develop an integrated protected area programme, with adequate trained staff, and adequate patrolling, censusing and mapping Convert the El-Bohayrat area into an attractive environmental recreational area for the citizens Rehabilitate important wadis (Wadi Hanifa and Wadi Sulay, El-Haysia, Laban, etc) by cleaning and setting up visitor facilities
Green space (e.g.. parks, gardens) Wildlife preservation	Ensures a green city, which acts as carbon sink and home to both local and foreign flora	Increase the greening ratio in the urban area (Green Riyadh Program) Establish a Greenovation hub that undertakes innovation, research and monitoring to further develop and support the Green Riyadh plan – including an urban wildlife monitoring program with the help of citizens Employ policies to encourage vertical/roof gardens in new buildings using hydroponics, grey water Encourage ‘productive landscaping’ with planting of food plants and indigenous plants in new developments Mandate all new developments to have minimum 9% green space to be in line with Green Riyadh plan
Wildlife preservation	Ensures preservation of endangered local wildlife	Create a common platform to discuss biodiversity by implementing Singapore Index to measure progress and set goals Assessing, mapping and protecting Riyadh’s native & invasive species, focusing on threatened species (Critically endangered, Endangered, Vulnerable, Conservation Dependent) Monitoring and developing the markets as well as ensuring that there is no trading of the species vulnerable to extinction Rehabilitation and protection of the wildlife that is negatively impacted because of the urban developmental processes in the city

20+

other initiatives identified

3+

national and Riyadh-specific plans and strategies developed



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