

# Research, Development and Innovation (RDI) in Sustainability & Essential Needs

## JOINT INNOVATION OUTLOOK







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A hand holds a dark, moist soil core with a small green tomato seedling growing from it. The background is a blurred outdoor scene with a green lawn and trees. In the foreground, a black plastic bag with the word 'SWEDEN' is visible, and a shovel is partially buried in a pile of soil.

# 01

## *EXECUTIVE SUMMARY*

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## THE URGENCY OF NOW

In recent years, the Kingdom of Saudi Arabia has embarked on a transformative journey to address sustainability and essential needs through a robust Research, Development, and Innovation (RDI) agenda. As we stand at a crucial juncture, our goal is to establish the Kingdom as a global leader in tackling environmental challenges and enhancing resource management. Central to this transformation is a clear and ambitious strategy to position KSA among the top innovators by 2040, with a focus on critical areas such as water management, food security, environmental conservation, and energy efficiency.

KSA faces considerable challenges, including being one of the world's top 10 most water-stressed nations and experiencing temperature increases at twice the global average. Additionally, the Kingdom relies heavily on imported food, with only 1.6% of its land being arable<sup>1</sup>. However, these challenges present unique opportunities for innovation. We have been addressing these issues through initiatives like the Saudi Green Initiative and the National Renewable Energy Program, which aim to reduce carbon emissions, increase renewable energy capacity, and promote sustainable agricultural practices. Our nation has always emphasized RDI, and we have already made significant progress through the launch of numerous initiatives. The government, including key ecosystem drivers such as MEWA (Ministry of Environment, Water, and Agriculture) has committed over SAR 3 Bn to key projects in water management and agriculture technologies. The private sector, including major players like Saudi Aramco, SABIC, Al marei and others is also driving innovation through strategic investments and partnerships, further bolstering the Kingdom's efforts.

We invite your attention, partnership, and participation in this national journey.

## OUR GUIDING PRINCIPLES



The global landscape for RDI in sustainability is rapidly evolving, with increasing emphasis on circular economy practices, disaster resilience, and innovative waste and water management tools. KSA's RDI agenda is guided by a comprehensive set of policy directives that outline a clear roadmap for the future. These policy guidelines prioritize stable and increased funding, active private sector participation, and the efficient utilization of resources.

The Kingdom has already established a strong framework for RDI, exemplified by the creation of the Research Development and Innovation Authority (RDIA). RDIA, in coordination with MEWA, plays a central role in coordinating efforts across the public and private sectors, academia, and international partners. These initiatives are part of a broader mission-oriented approach adopted by the Kingdom, focusing on high-impact goals such as achieving net-zero emissions by 2060, significantly reducing non-renewable water use, and enhancing food self-sufficiency.

The guiding principles outlined in this document provide a structured and collaborative framework between RDIA and MEWA for steering KSA's RDI efforts in sustainability and essential needs. By advancing water technologies, promoting climate-resilient agriculture, and improving waste management practices, KSA is not only addressing its own needs but is also positioned to make significant contributions to global sustainability. The Kingdom is set to create a dynamic and innovative sustainability sector that not only tackles current challenges but also seizes opportunities for groundbreaking advancements.





# RDI ACTION PLAN OF THE KINGDOM OF SAUDI ARABIA

The Kingdom of Saudi Arabia has adopted a mission-oriented approach. This approach is designed to set clear, achievable goals supported by strong collaboration between the public and private sectors. The mission-oriented strategy provides the necessary framework to ensure that all efforts align with the broader strategic objectives of Vision 2030 and beyond, enabling KSA to tackle its most pressing challenges through focused, coordinated, and impactful actions.

We have identified seven specific missions in sustainability and essential needs, centered on more efficient resource use, reducing carbon footprints, and enhancing the self-sufficiency of our growing nation. These missions are detailed in section three of this document.

These missions will primarily be executed using technologies developed and refined within the Kingdom. The research, development, and commercialization processes will take place here, driven by knowledge workers from both the Kingdom and around the world, working in KSA's labs, institutions, startups, and large companies. This is the strength of our mission-oriented approach: it not only addresses current challenges but also builds a robust innovation ecosystem. This will empower us to tackle future challenges even more effectively, making KSA an increasingly attractive destination for global entrepreneurs to realize their visions and a compelling partner for international companies and research institutions.

## ***The following missions have been identified for sustainability and essential needs:***

- Decrease the withdrawal of non-renewable water by 90% and reduce the cost of water production by 50% by 2035.
- Develop technologies in food for sustainable and resilient food systems to achieve more than 50% self-sufficiency by 2040.
- Achieve net-zero emissions by 2060.
- Plant 10 billion trees across KSA by 2040.
- Protect 30% of the Kingdom's land and sea by 2035.
- Reduce summer surface temperatures by 4°C by 2040.
- Develop and adopt innovative cooling technologies to reduce cooling electricity consumption by 30% by 2040.

KSA's strategic focus on Research, Development, and Innovation (RDI) is now being tailored to meet the critical demands of sustainability and essential needs. We are undertaking targeted interventions that address key RDI enablers, ensuring that our efforts directly contribute to sustainable development and the fulfillment of essential sectors such as energy, water, and food security. By aligning our RDI priorities with global sustainability goals, the Kingdom is positioning itself to tackle the world's most pressing challenges through breakthrough innovations and cutting-edge solutions.

This approach encompasses robust support for RDI funding aimed specifically at sustainable technologies, along with programs designed to cultivate top-tier talent in these critical fields. Policies are being crafted to ensure seamless collaboration and the free flow of ideas and expertise, fostering a collaborative ecosystem where sustainability-driven innovation can thrive. By focusing on these enablers, Saudi Arabia is building a future-ready RDI ecosystem that not only addresses essential needs but also leads the global transition toward a more sustainable and resilient economy.





**1. Human Capital and Talent:** We are investing heavily to enhance STEM education at all levels, complemented by programs to train Saudi engineers and researchers while attracting foreign talent to study and work in the Kingdom of Saudi Arabia



**2. Funding:** A strong innovation economy requires robust funding. We have established and launched a national research grants agency with billions of Riyals earmarked for research projects, primarily at academic institutions. This funding also supports joint projects between academia and the private sector, large consortia involving both local and international institutions, and technology development and commercialization efforts.



**3. National policy guidelines:** Our innovation economy is supported—and can be constrained—by national policies. This document outlines bold and comprehensive policy changes within the Kingdom, creating a more fluid and dynamic innovation economy that facilitates the movement of capital and talent (of all nationalities) into KSA and enhances our engagement with global innovators.



**4. Infrastructure:** Innovation requires a strong supporting infrastructure, both physical and human. We have launched programs to create workspaces, labs, and supportive facilities necessary for R&D and commercialization within our sustainability and essential needs missions. Additionally, our new initiatives address the supply chain and human capital aspects of innovation through novel and innovative programs.



**5. Connectivity:** An innovation economy thrives on connections. Researchers, institutions, and companies must be able to find and collaborate with each other. Too often, innovation strategies overlook this “soft” side of innovation. We have not. In the body of this outlook, you will find a series of specific programs designed to create, drive, and support these crucial, often-neglected linkages.

***This is our bold strategy to build a world-class ecosystem for research, development, and technological advancement.***

As KSA continues to push forward on this ambitious path, the integration of these efforts under the Vision 2030 framework is set to yield substantial progress in sustainability and essential needs. By addressing the pressing challenges with innovative solutions and leveraging its unique strengths, the Kingdom is not only securing a sustainable future for its citizens but also setting a global standard in environmental stewardship. This joint innovation outlook serves as a testament to the strides KSA is making toward becoming a leader in global sustainability, reflecting a future where prosperity and environmental responsibility go hand in hand.



# 02

## *INTRODUCTION*

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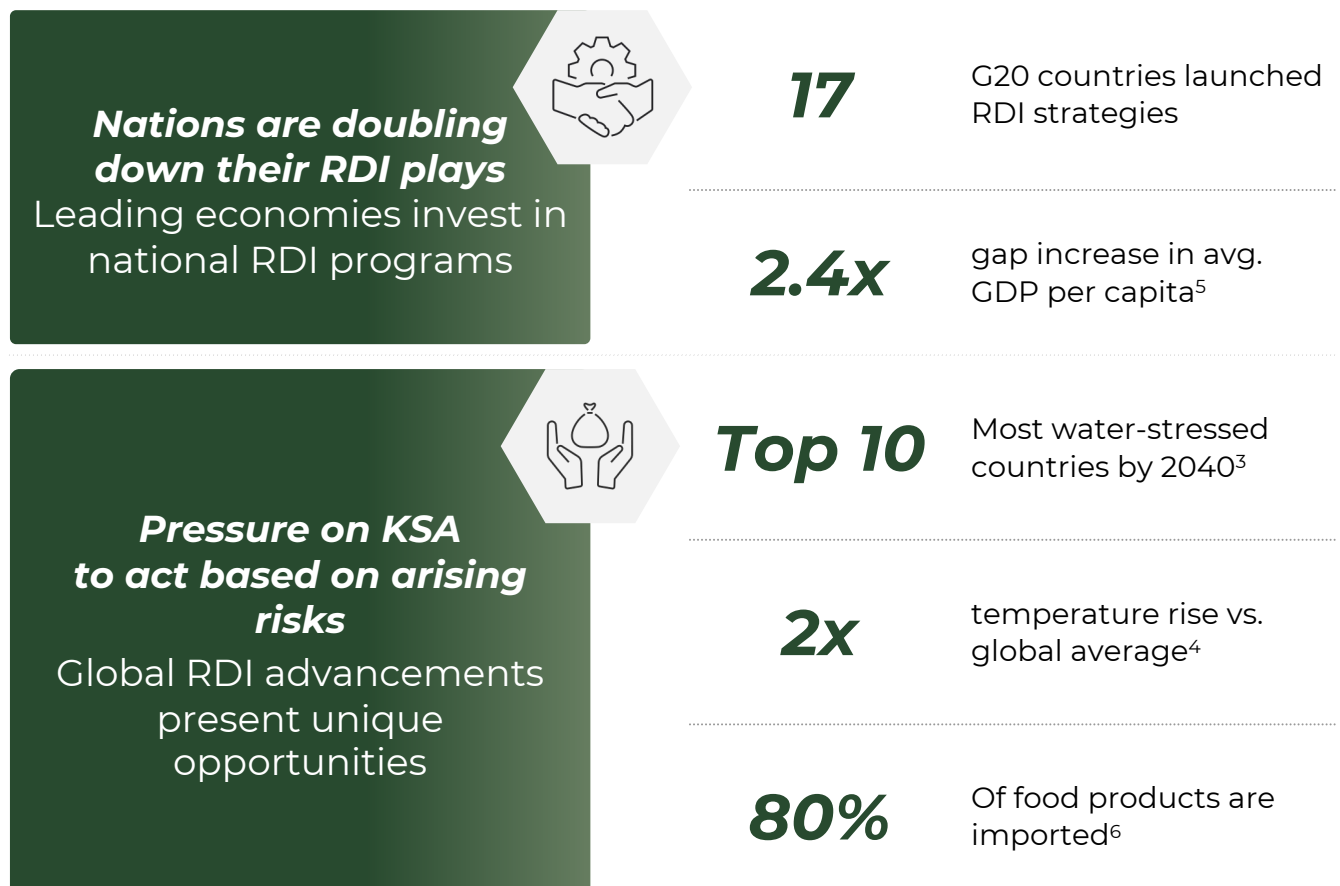


## 2.1 THE RDI AGENDA IN THE KINGDOM OF SAUDI ARABIA

**For the Kingdom of Saudi Arabia, investing in RDI is essential to enhance its global standing and economic performance.** Analysis shows that the top 10 nations on the Global Innovation Index (GII) consistently outperform others in GDP growth<sup>1</sup>, demonstrating a clear link between innovation and economic success. Furthermore, 22 out of the 25 leaders in the Soft Power Index are also ranked in the top 30 of the GII<sup>2</sup>, indicating that innovative countries also wield significant global influence. By prioritizing RDI, KSA can boost its economic growth, enhance its international influence, and achieve its ambitious Vision 2030 goals.

**Prioritizing RDI enables KSA to address critical sustainability and essential needs-related challenges and drive economic progress.** The nation currently ranks among the top 10 most water-stressed countries by 2040<sup>3</sup> and shows a 2x higher temperature rise vs. the global average<sup>4</sup>. These pressing issues provide a unique opportunity for innovation. By investing in research and development, KSA can lead the way in pioneering solutions to combat these conditions, increasing sustainability and reducing economic burdens. Embracing RDI not only targets these crucial concerns but also positions the Kingdom as a leader in sustainability and essential needs, aligning with Vision 2030 goals and enhancing its global reputation.

**Figure 1: Why now | Pressure is rising to compete in Sustainability and Essential Needs**



1. WIPO and World Bank; 2. Soft Power Index and GII; 3. Bloomberg; 4. The Washington Post; 5. In developed vs. developing nations in 50 years - UNCTAD "Technology and Innovation report 2021"; 6. "Agricultural marketing situation analysis in the Kingdom of Saudi Arabia" 2022 by MEWA





## 2.2 GUIDING PRINCIPLES FOR RDI IN SUSTAINABILITY AND ESSENTIAL NEEDS

The Kingdom of Saudi Arabia is on a transformative journey in the Sustainability and Essential Needs sector, leveraging RDI to drive significant advancements. To accelerate this journey, certain guiding principles, or guardrails, are essential. These principles ensure that there is a clear direction and provide guidance for all stakeholders involved in the RDI ecosystem. By adhering to these principles, KSA aims to establish itself as a global leader in sustainability and essential needs.

**1. Resource Conservation and Environmental Protection - Prioritize the conservation of natural resources while protecting and restoring ecosystems to ensure the environment's long-term health.** KSA recognizes the importance of conserving these resources for future generations. This principle underscores the need for sustainable management of resources, including water, energy, and land. Protecting and restoring ecosystems is also vital to preserving biodiversity, which in turn supports the resilience of natural systems.

**2. Technology Localization and Innovation - Encourage the development and adoption of locally produced technologies tailored to the specific needs of KSA's environment and society.** This principle focuses on fostering the development of homegrown technologies that are specifically designed to address the Kingdom's challenges. Whether desalination technologies adapted to the arid climate, or renewable energy solutions that harness the abundant solar power, KSA aims to reduce its reliance on imported technologies.

**3. Self-Reliance - Strengthen national self-reliance by ramping up localized food supply through the development and implementation of local technologies.** The Kingdom seeks to reduce its dependence on imported goods and technologies, particularly in critical sectors like food and water. By developing and implementing localized technologies, KSA aims to enhance its food security, ensuring that a significant portion of its food supply is produced within the country.

**4. Accessibility and Equity - Ensure that sustainable resources are accessible and affordable to all citizens.** KSA is committed to ensuring that the benefits of sustainability are enjoyed by all segments of society. This principle emphasizes the importance of equitable access to essential resources and stresses the need to make sustainable technologies affordable and widely available, ensuring that even the most vulnerable populations can benefit from advances in RDI.

**5. Circular Carbon Economy Integration - Embed circular carbon economy principles into all RDI activities to manage carbon emissions.** KSA recognizes the importance of addressing carbon management through innovative RDI efforts. This principle emphasizes the integration of circular carbon economy considerations into all aspects of research and development, from capturing and utilizing carbon to promoting technologies that support a closed-loop system for carbon.

**6. Resource Utilization Optimization - Maximize the efficiency of resource use across all sectors to minimize waste and enhance sustainability.** By adopting cutting-edge technologies and best practices, KSA aims to reduce inefficiencies in resource use, leading to decreased waste, lower environmental impact, and more sustainable economic growth.

**7. Quality of Life and Sustainable Development - Balance economic growth with environmental sustainability to enhance the overall quality of life for citizens.** KSA's vision for the future is one where economic prosperity goes hand in hand with environmental stewardship. By integrating sustainable practices into urban planning, industrial development, and social policies, KSA aims to create thriving communities that enjoy the benefits of economic growth without compromising the environment.





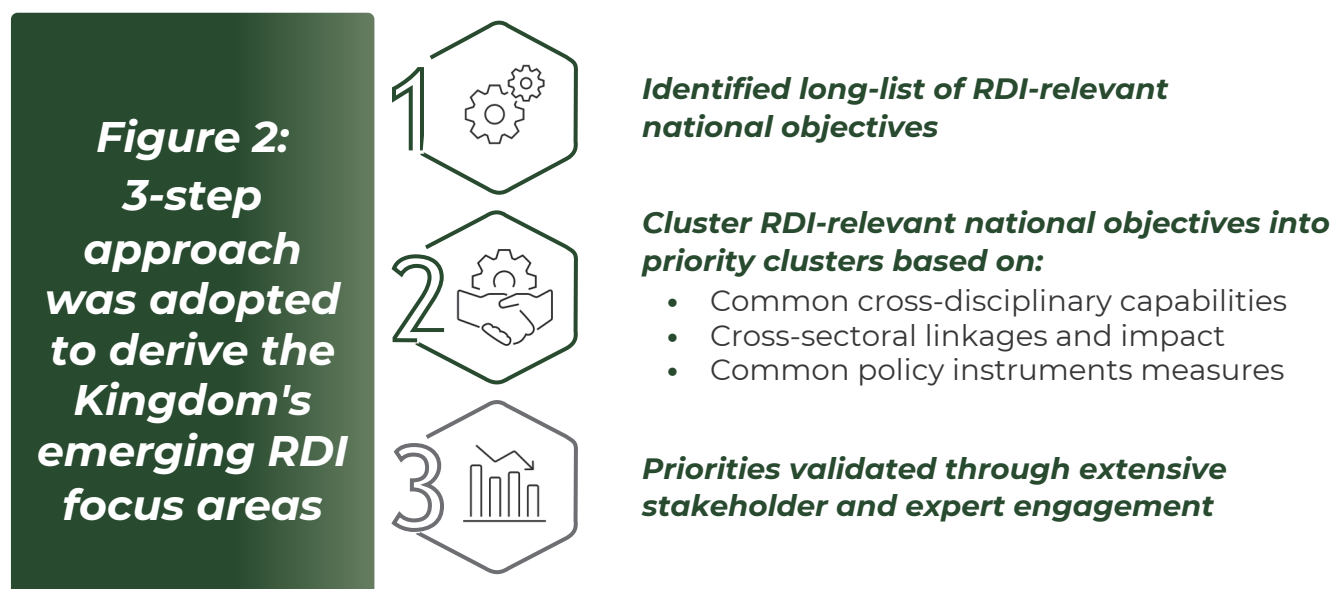
## 2.3 KSA's national RDI focus areas

### 2.3.1 Defining KSA's national RDI focus areas

For the realization of the RDI agenda in KSA, as laid out in the previous section, it is essential to introduce focus areas to provide clear direction for RDI efforts. They ensure that resources are effectively allocated, collaborations fostered, and impactful outcomes achieved in alignment with Vision 2030. By defining specific focus areas, the Kingdom of Saudi Arabia can streamline its efforts and avoid fragmentation. Besides enhancing efficiency, this targeted approach amplifies the impact of RDI initiatives, driving comprehensive advancements in key sectors, and ensuring that they contribute meaningfully to national development goals.

**Globally, RDI paradigms are shifting towards multi-disciplinary priorities to address pressing challenges.** This shift is driven by several key factors. First, it involves mobilizing cross-sectoral and multi-disciplinary capabilities from idea to market, ensuring that diverse expertise and resources are harnessed to tackle complex problems. Second, concentrating and coordinating RDI investments towards measurable goals enables performance management and ensures that funds are used effectively. Creating accountability to facilitate the achievement of RDI priorities is another critical driver, as it ensures that all stakeholders are committed to delivering results.

This targeted, multi-disciplinary approach also enables the realization of national ambitions by synchronizing non-RDI policy and regulatory measures, accelerating the uptake of innovations through demand signaling, and boosting private sector engagement. Improving the communication of goals and impacts ensures that the benefits of RDI efforts are clearly understood and appreciated by all stakeholders.



**Figure 3: Four RDI focus areas for KSA were identified**

**01**



### **Health & Wellness**

- Solve KSA's prevalent medical and behavioral **health challenges**
- Achieve early prevention of diseases through **personalized wellness and healthcare** services
- Disrupt **digital healthcare** to ensure health equity across the Kingdom (based on AI use cases)

**02**



### **Sustainability and Essential Needs**

- **Sustainably secure supply of water, food and power** to the population and industry (localized food supply)
- Become a global exporter of **advanced water & food techs (e.g., water desalination)**
- Establish KSA as a global paradigm on **environmental conservation** (e.g., coral reefs)

**03**



### **Energy & Industrials**

- Maintain & extend KSA's **global leadership position in energy** supply
- Establish KSA as a regional hub for **specialty chemical** derivatives
- Ensure hydrocarbon demand sustainability through **advanced non-metallic products, blue hydrogen & COTC2**

**04**



### **Economies of the Future**

- Reimagine the **future of urban living** through hyper-connected cognitive cities
- Become a global **space/deep sea champion**, creating economic value from RDI spillover effects
- Foster **digital technology frontiers** in priority sectors to build a regional/ global edge (e.g., AI applications incl. genAI/AGI or semiconductors)



### 2.3.2 Global trends and the RDI imperative

Research, Development, and Innovation are pivotal for advancing global economies, particularly in addressing sustainability and essential needs. The global significance of RDI in this area is underscored by substantial investments and initiatives worldwide. Countries and international organizations are increasingly recognizing the critical role of RDI in advancing sustainable practices, addressing environmental challenges, and ensuring resource security.

**The global sustainability and essential needs landscape is undergoing significant transformation, driven by emerging trends** that highlight the necessity for robust RDI. These trends underscore the importance of RDI in developing innovative solutions to address environmental challenges and improve overall sustainability.

**Figure 4: Key trends shaping sustainability and essential needs**



**The concept of a circular economy is gaining traction as a means to create a closed-loop system that minimizes waste and maximizes the use of resources.** This economic model focuses on recycling, reusing, and remanufacturing materials to create sustainable production and consumption patterns. The **global circular economy market is projected to reach approximately \$1.5-4.5 trillion by 2030**, driven by the need to reduce greenhouse gas emissions and resource consumption.

One of the world's most critical challenges is the increasing impact of climate change and global warming. Human activities, particularly the burning of fossil fuels, have significantly altered the Earth's climate, causing global temperatures to rise. This has led to extreme weather events and natural disasters. **Currently, more than 70 countries, including some of the largest carbon emitters, have set net-zero emissions targets, reflecting a global push towards sustainable practices** and the urgent need for innovative solutions to mitigate climate impacts.

**With rising levels of waste comes a corresponding focus on waste management.** As global consumption increases, so does the production of waste, including electronic waste. The global **generation of municipal solid waste is expected to increase to 3.4 billion tonnes by 2050**, up from 2.01 billion tonnes in 2016. Sustainable waste management practices, such as recycling, composting, and waste-to-energy technologies, are becoming increasingly important. New regulations and political efforts are being implemented worldwide to improve waste management and reduce environmental and health impact.

**Innovations in energy-efficient technologies and the transition to renewable energy sources are essential** for reducing carbon footprints throughout the global economy. The market for electric vehicles (EVs) is growing rapidly, with **global EV sales expected to reach 31.1 million units by 2030**, up from 2.5 million in 2020, reflecting a significant shift towards sustainable transport solutions that decrease dependency on fossil fuels and lower emissions.

The rise of green products and markets reflects consumer demand for environmentally friendly products. **Companies are increasingly investing in the development of green products**, which include everything from biodegradable materials to energy-efficient appliances. The global market for green technology and sustainability is anticipated to reach \$48.36 billion by 2027, growing at a CAGR of 24.3% from 2020 to 2027. This trend is supported by the adoption of regulatory frameworks that encourage sustainable production and consumption.

Lastly, the **integration of AI in climate modeling is revolutionizing the ability to predict and manage climate change** by enhancing the accuracy, resolution, and interpretability of climate forecasts. The global AI in climate change market is estimated to grow at a CAGR of 20.3% from 2021 to 2027, highlighting the critical role of RDI in driving the creation of more sophisticated AI models, improving data quality, and ensuring that these tools are used responsibly and effectively to address the global climate crisis.



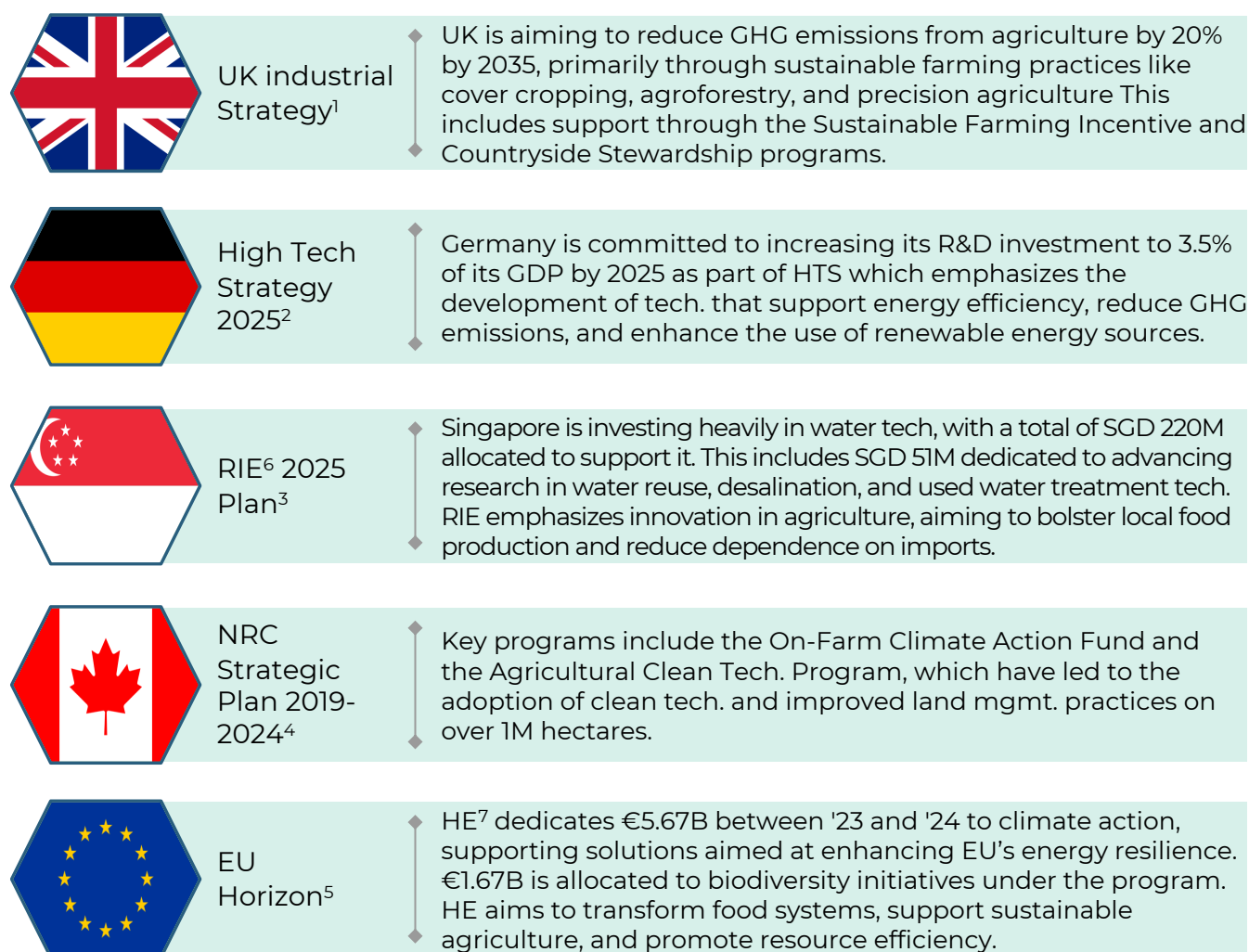


The global significance of RDI in sustainability and essential needs is underscored by substantial investments and groundbreaking initiatives worldwide. Countries and international organizations are increasingly recognizing the critical role of RDI in addressing environmental challenges, ensuring resource security, and promoting sustainable development. These efforts are crucial for driving innovation and achieving long-term sustainability goals.

The European Union's Horizon Europe program, with a budget of €95.5 billion over seven years, prioritizes areas such as climate change and sustainable agriculture. This program includes missions like achieving climate-neutral cities and enhancing soil health, highlighting the EU's commitment to tackling environmental challenges through RDI.

China is a global leader in sustainability RDI, with investments surpassing \$378 billion in 2022. The country focuses on sustainability technologies, water conservation, and sustainable urban development, aiming to become a global leader in green technology. Meanwhile, the United Kingdom's Innovation Strategy commits £22 billion annually to RDI by 2027, emphasizing low-carbon technologies, green finance, and sustainable infrastructure to drive economic growth while reducing environmental impact. Japan's Society 5.0 initiative integrates physical and digital spaces to create a super-smart society, leveraging AI, IoT, and robotics to enhance sustainability efforts.

**Figure 5: Countries around the world are focusing on RDI initiatives in sustainability and essential needs:**



1. Sourced from GOV.UK and DEFRA farming websites 2. Sourced from BMBF, Federal Government Report on HTS 3. Sourced from PUB, Singapore's National Water Agency website 4. Sourced from the Office of the Auditor General of Canada 5. Sourced from European Commission website 6. Research and Innovation Enterprise 7. Horizon Europe

### 2.3.3 Key challenges in Sustainability and Essential Needs

The Kingdom of Saudi Arabia faces escalating climate challenges, including rising temperatures, extreme weather, water scarcity, soil degradation, and biodiversity loss. Addressing these requires innovative solutions, resilient infrastructures, and advanced waste management technologies. Despite these challenges, KSA's unique strengths and potential offer significant opportunities for progress in sustainability and essential needs through a comprehensive RDI strategy.

KSA's challenges exacerbate water scarcity, soil degradation, and biodiversity loss, challenging the Kingdom's environmental resilience. Innovative solutions and resilient infrastructures are essential to combat these issues. Additionally, waste management is a growing concern, necessitating advanced recycling and waste-to-energy technologies to reduce environmental impact. These challenges require a comprehensive and coordinated RDI strategy to develop sustainable practices and technologies, ensuring a balanced and resilient ecosystem.

However, KSA also possesses unique strengths and immense potential, offering opportunities to make substantial progress in sustainability and essential needs by leveraging RDI.

**Figure 6: KSA faces several critical challenges today across three key areas**



KSA's agricultural and food sector faces numerous challenges due to unfavorable climate conditions and low productivity, resulting in heavy reliance on imported food products. The harsh climate and scarce water resources limit the potential for conventional farming, with arable land covering only 1.6% of the country's total area. Additionally, the prevalence of small and medium-sized farms contributes to low yield productivity. The sector also struggles with high levels of pests and diseases, affecting both livestock and fish.



KSA encounters various challenges in managing its water resources. The country's water sector is characterized by scarce water resources and significant use of desalinated water, with minimal reuse of untreated municipal water for irrigation. Enhancing efficiency in this area is crucial to sustainably increase local food production and support the Saudi Green Initiative.



The country is facing a series of environmental and sustainability challenges. The natural environment is under significant pressure, with various ecosystems experiencing degradation. Air quality in urban areas is a concern and waste management practices are sub-optimal. To maintain global competitiveness and ensure a sustainable environment, research, development, and innovation in net-zero technologies are crucial.

In addition to these challenges, KSA's sustainability and essential needs sector faces several significant issues. Rural areas struggle with inadequate infrastructure, resulting in limited access to essential resources like water and energy. Rapid urbanization and population growth further strain existing systems, leading to inefficiencies and resource shortages. There is also a pressing need for improved data management systems to optimize resource allocation and enhance operational efficiency. Addressing these multifaceted challenges is crucial for achieving equitable, efficient, and high-quality resource management for all citizens.

Moreover, less than 20% of essential value chains, such as those for water and energy, are localized, posing risks to national security. Inconsistent access to high-quality resources across regions leads to unequal outcomes, and environmental degradation exacerbates these issues. Despite these challenges, KSA is actively working to transform its sustainability landscape through strategic investments in RDI, aiming to improve resource management, enhance infrastructure, and promote overall environmental well-being for its citizens.

Significant initiatives, such as the Saudi Green Initiative and the National Renewable Energy Program, highlight the Kingdom's commitment to sustainability. The Saudi Green Initiative, for example, holds several key targets including planting 10Bn trees (part of a broader regional initiative to plant 50Bn trees across the Middle East), designating 30% of KSA's land and marine areas as protected areas by 2030, reducing carbon emissions by 278Mn tons per annum by 2030, and generating 50% of the Kingdom's energy from renewable sources by 2030, significantly reducing reliance on fossil fuels and promoting the use of solar and wind energy.

## Figure 7: Key figures highlighting KSA's sustainability and essential needs challenges

### Agriculture and food



**1.6%** Arable land as a percentage of the total area

**17** hectares average farm size compared to the global average of 77 hectares

**17%** of all diseases impacting livestock and fish are under control

**\$15.2** million annual losses due to infected palm weevils

**30%** of produce and animal products are wasted before reaching consumers

**High reliance** on imported food products to meet domestic needs

### Water



**Top 10** most scarced water nation by 2040

**Top 1** country in desalinated water production

**~8 Bn** m<sup>3</sup> per year of total fresh underground water withdrawn

**71 m<sup>3</sup>** per year per capital of renewable water resources, significantly below the global average of about 17,900 m<sup>3</sup> per year

**~340 m<sup>3</sup>** per capita of agricultural water consumption<sup>1</sup>

**~98 m<sup>3</sup>** per capita of urban purposes water consumption<sup>1</sup>

**~17 m<sup>3</sup>** per capita of industrial water consumption<sup>1</sup>

### Environment



**75%** decrease in mangrove forests between 1985 and 2013, vital coastal ecosystems that protect shorelines and support biodiversity

**70%** of rangelands are suffering from desertification, a process that turns fertile land into deserts

**95 µg/m<sup>3</sup>** volume of nitrogen dioxide in Riyadh, far above the recommended 40 µg/m<sup>3</sup> by WHO

**500+ Mn** tonnes per annum of CO<sub>2</sub> emissions

**5** KSA animal species became extinct and **111** species currently threatened

<sup>1</sup> MEWA Stats for 2022  
Source: World Bank, FAO Aquastat, SWCC, Custos e Agronegocio (accessed through ResearchGate)



### 2.3.4 Strong momentum and key Opportunities

**The Kingdom of Saudi Arabia boasts a unique value proposition and strong momentum in sustainability and essential needs, making it well-positioned to advance RDI-driven solutions.** This comprehensive approach is designed to ensure sustainable development and enhance the country's capabilities in the following crucial areas.



#### **Agriculture and food**

KSA has significant potential in the agricultural sector. Its extensive marine ecosystem and over 2,600 km of coastline can be leveraged to boost aquaculture. The country is home to the largest regional food production companies, such as Almarai and Supreme Foods Processing Company, which have strong capabilities and substantial sales revenues (\$4.1 billion and \$2.2 billion in 2020, respectively). KSA has a dedicated biotechnology strategy focused on biological crop optimization and cellular agriculture, aimed at driving climate-resilient farming. This strategy is supported by established Agritech research centers like the National Center for Sustainable Agriculture Research and Development (Estidama) and the Global Forum on Agricultural Research (GFAR).



#### **Water**

KSA is the world's largest producer of desalinated water, generating approximately 11.5 million cubic meters per day (projected to reach 13.3 million cubic meters in 2024). It boasts the lowest production cost across all technologies, with ACWA Power producing desalinated water at 1.37<sup>1</sup> SAR/m<sup>3</sup>. The country has strong local research and development (R&D) capabilities and intellectual property generation focused on advanced water technologies, such as Zero Liquid Discharge (ZLD), Forward Osmosis (FLD), Reverse Osmosis (RO) membranes, and renewable energy integration.



#### **Environment**

KSA is a leader in the circular carbon economy, positioning itself strongly to drive the Middle East's green agenda through initiatives like the Saudi Green Initiative. The country covers a large territory with diverse terrestrial ecosystems, hosting approximately 6,000 species, including 2,282 flora and 3,720 fauna species, with over 1,000 species endemic or native to the Arabian Peninsula. KSA is also growing its capabilities in carbon capture, with projects like the Aramco Hawiyah pilot and centers of excellence such as the King Abdulaziz City for Science and Technology (KACST) and the Ministry of Energy's Center of Excellence in Carbon Capture, Utilization, and Storage (CCUS).

**The global focus is shifting from reactive measures to proactive, long-term sustainability solutions.** This paradigm shift emphasizes the importance of early intervention and continuous innovation to improve overall resource management and environmental outcomes with initiatives such as:

- **Advanced Water Technologies:** Developing cutting-edge water desalination and conservation technologies to enhance national water security and reduce reliance on non-renewable water sources.
- **Renewable Energy Solutions:** Focusing on the development and deployment of cost-effective renewable energy technologies to boost economic contribution and reduce carbon emissions.
- **Sustainable Agriculture:** Promoting climate-resilient farming practices and innovative agritech to improve food security and reduce dependency on food imports.

**A significant aspect of the new sustainability paradigm is fostering a circular economy.** This involves shifting from a linear "take-make-dispose" model to a closed-loop system that emphasizes recycling, reusing, and remanufacturing materials. Key strategies include ensuring resource efficiency, implementing policies that support sustainable production and consumption, and enhancing the overall well-being of the environment through targeted sustainability initiatives.

**RDI will play a central role in mitigating KSA's sustainability challenges.** By addressing prevalent issues such as water scarcity, food security, and environmental degradation, KSA aims to ensure resource equity across the Kingdom. Additionally, supplying the world with cutting-edge sustainable technologies and practices will position KSA as a leader in the global sustainability market. By focusing on these areas and leveraging its unique strengths, KSA is poised to transform its sustainability and essential needs sector, improve the quality of life for its citizens, and achieve its Vision 2030 goals.

**Figure 8: Strong momentum observed in the RDI ecosystem, championed by local content innovators across sectors**







**03**

***KSA'S APPROACH TO  
SUSTAINABILITY  
& ESSENTIAL NEEDS RDI***

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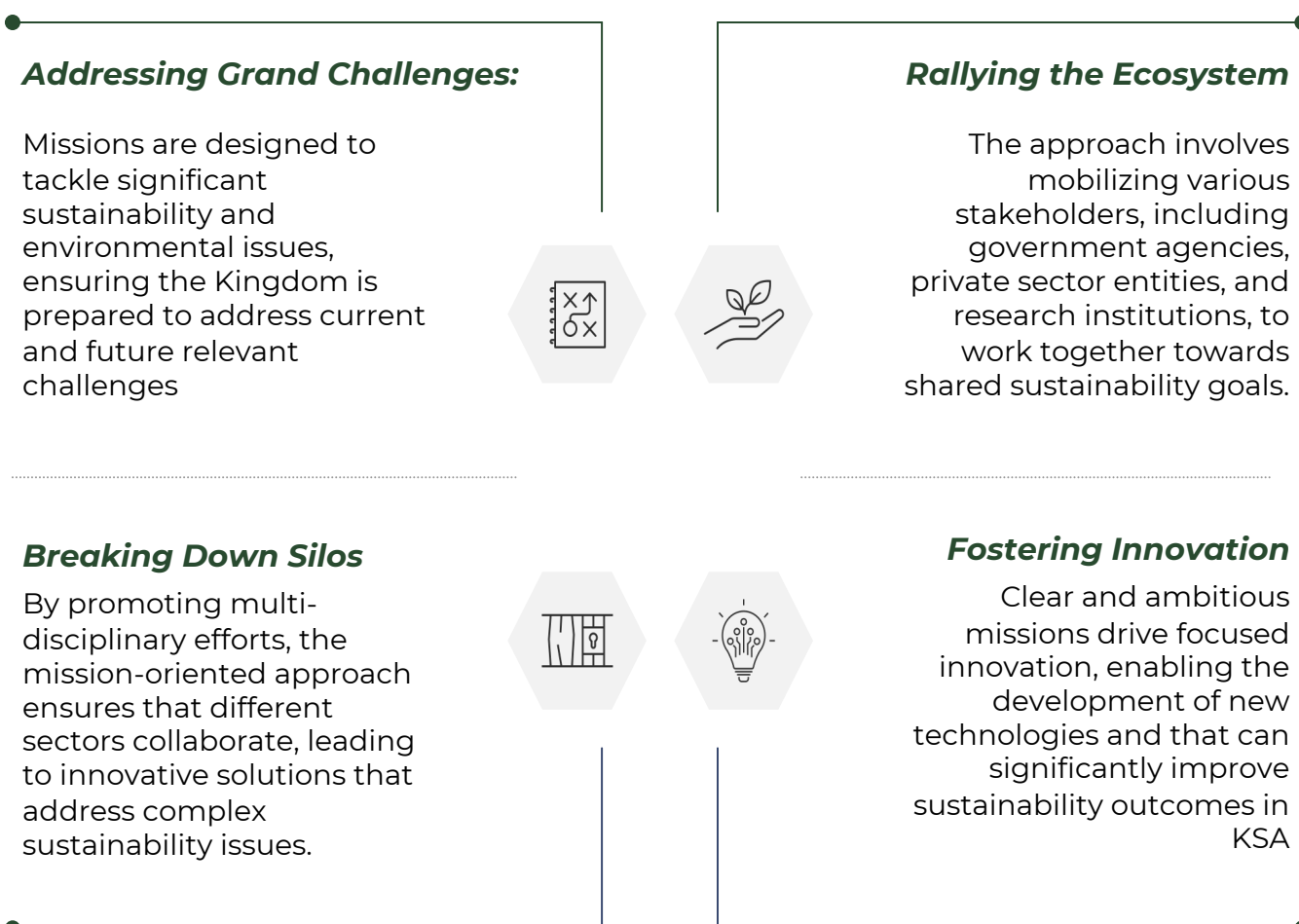
### 3.1 OVERVIEW OF RDI MISSIONS

To achieve the Kingdom's ambitious sustainability goals, tackle major challenges, and leverage opportunities for innovation, a mission-oriented approach has been adopted for its RDI strategy in the Sustainability and Essential Needs sector. Each mission features clear, achievable goals backed by substantial public and private sector collaboration. This systemic approach to solving complex sustainability issues ensures that efforts are focused, coordinated, and impactful. By targeting specific missions, KSA can rally the ecosystem and nation behind bold and ambitious targets, breaking down silos and fostering multi-disciplinary efforts.

### 3.2 MISSION-ORIENTED APPROACH

KSA's sustainability and essential needs sector faces critical challenges, including water scarcity, inconsistent access to energy resources, and low localization of essential value chains. These issues necessitate a robust RDI strategy that addresses the immediate issues while also promoting innovation and sustainable solutions. The mission-oriented approach is essential for transforming these challenges into opportunities, enabling KSA to achieve its Vision 2030 goals.

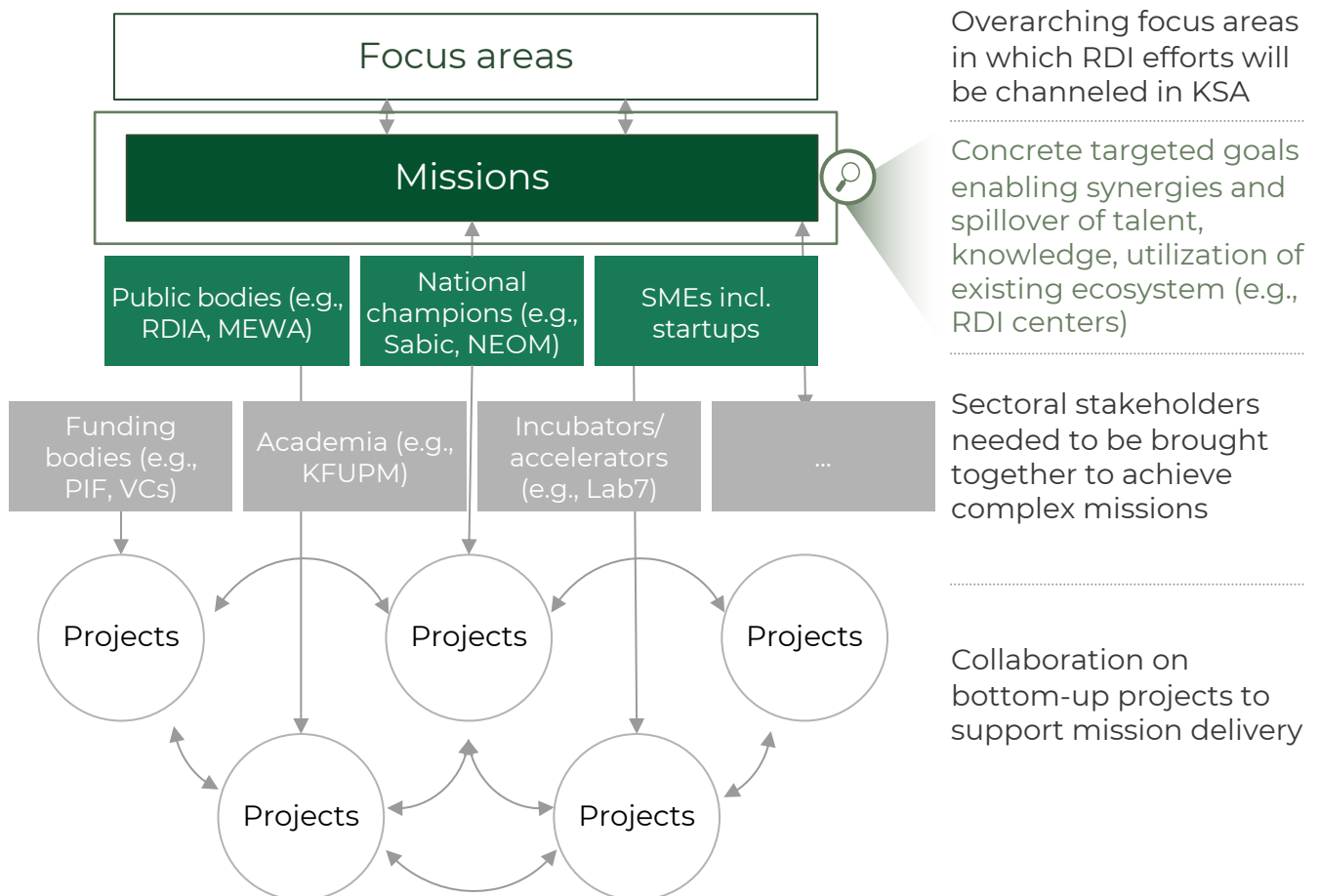
**Figure 9: Key Elements of the Mission-Oriented Approach**



The mission-oriented approach ensures effective achievement of ambitious targets by addressing grand challenges, mobilizing diverse stakeholders, promoting multi-disciplinary collaboration, and fostering focused innovation.

It also emphasizes the importance of integrating global best practices and local expertise to address sustainability challenges comprehensively. Through international collaborations and knowledge exchange, KSA can harness innovative ideas and advanced technologies to drive sustainable development. This approach ensures that the Kingdom remains adaptable to emerging trends and resilient in the face of environmental and resource-related challenges.

**Figure 10: Missions act as the glue connecting stakeholders in the ecosystem**



The mission-oriented approach is designed to address grand challenges to secure the present and win the future. It focuses on rallying the ecosystem and nation behind bold and ambitious targets, ensuring that all stakeholders are aligned and motivated. By breaking the silos of sectoral priorities and catalyzing multi-disciplinary efforts, this approach fosters collaboration across various sectors, enhancing the collective impact.

These guidelines are essential for driving significant advancements, ensuring that resources are effectively utilized, and creating a cohesive and dynamic innovation landscape. This strategic approach not only targets immediate goals but also sets the foundation for sustainable long-term success.

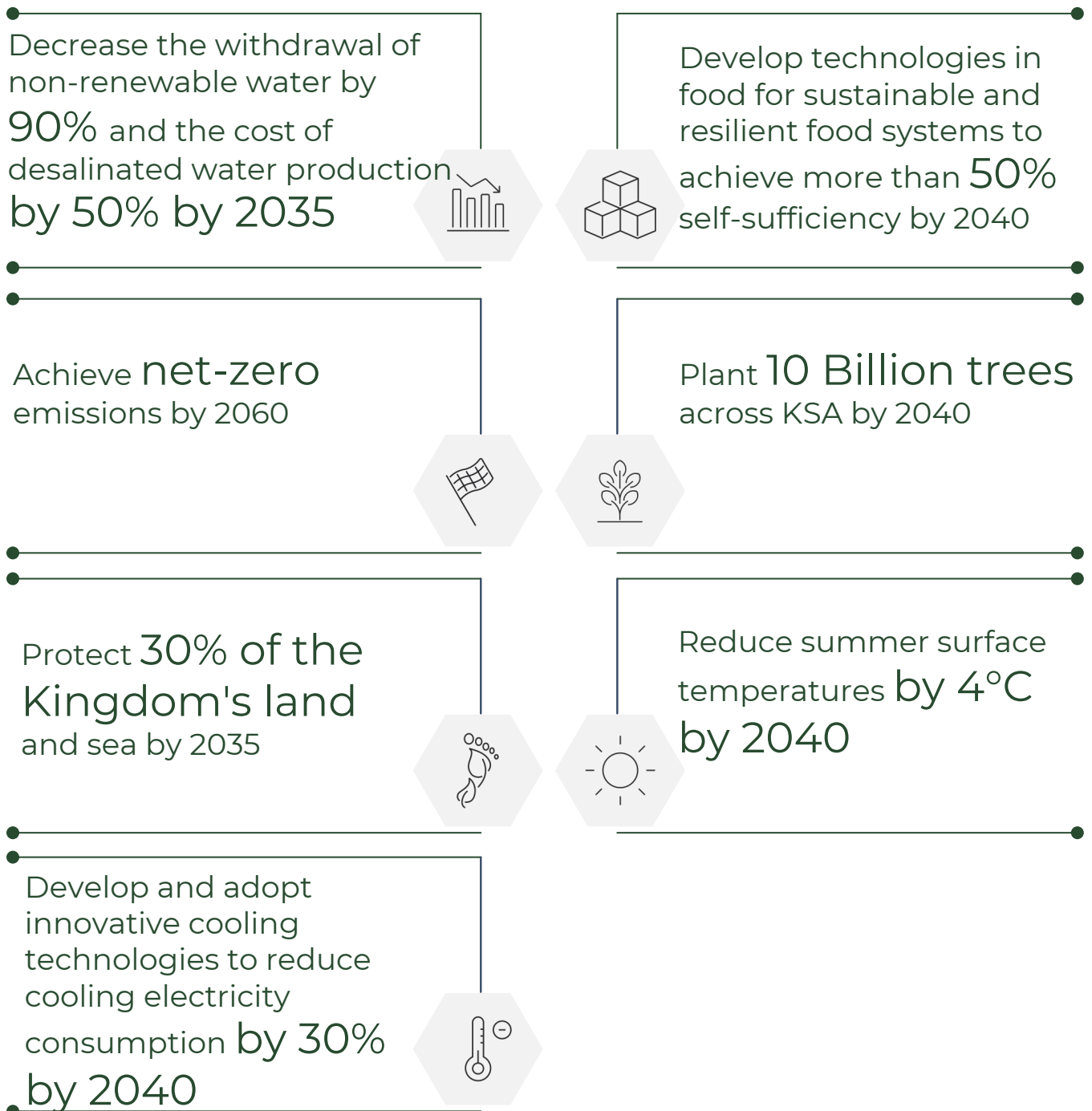
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### 3.3 SUSTAINABILITY AND ESSENTIAL NEEDS RDI MISSIONS

The Kingdom of Saudi Arabia has identified seven Sustainability and Essential Needs missions to address critical challenges and leverage opportunities for innovation. These missions are designed to ensure the sustainable supply of essential resources, promote environmental conservation, and position KSA as a leader in sustainability technologies. The mission-oriented approach ensures that these goals are ambitious, achievable, and backed by significant public and private sector collaboration.

**Figure 11: Missions focused on Sustainability and Essential Needs**



Decrease the withdrawal of non-renewable water by **90%** and the cost of water production **by 50% by 2035 (I/II)**



### Mission motivation

**The Kingdom of Saudi Arabia, the 8th most water-stressed country globally, faces rapidly depleting non-renewable groundwater reserves.** Currently, 60% of KSA's urban water supply comes from desalination, which is not efficient in terms of energy and cost. With national projects like planting 10 Bn trees and increasing food security, demand for water will only grow. This mission aims to achieve carbon circular and low-cost desalination, ensure sustainable exploitation of water resources, increase the efficiency of distribution and storage networks, and optimize water demand across sectors.

### Potential research areas (non-exhaustive)

#### Achieve carbon circular and low-cost desalination

- Pumpless small and medium scale desalination
- Implement AI and data analytics
- Elongating life of RO membranes
- Brine mining for Magnesium, Salt, Bromine, Au, U and Rb
- AI in process management, control and cost reduction
- Microbial Utilization & Bioreactors
- Enhancements, Optimization, & efficiency of Desalinations systems and technologies
- Innovative local manufacturing of components
- Innovative Data collection & transmission
- Better energy recovery for brackish water

#### Increase efficiency of distribution & storage networks

- Real time infrastructure optimization for utilities
- Remote metering and autonomous detection of leaks in water distribution networks
- Pipe life cycle assessment and mgmt. incl. corrosion
- Pumping systems and valves
- Novel storage to minimize reserve water stagnancy
- Decentralized water provision and treatment
- Digital twin of water requirement in areas of increased or high water consumption level
- New building codes to save water
- Reduce evaporation loss from reservoirs

#### Ensure sustainable exploitation of water resources

- Earth observation for water mgmt. and forecasting
- Integrated Water Resources Management through AI
- Managed Aquifer Recharge
- Aquifer Storage Recovery
- Water basin modeling and simulations
- Saline and potable groundwater interface (e.g., seawater intrusion)
- Artificial recharge of nonrenewable and slow-renewable waters
- Smart allocation of water to specific crops
- Increase recovery of brackish water desal to 95%
- ZLD brackish water desal

#### New desalination innovations

- Direct geothermal desalination
- Utilize 4D printing for making parts.
- New high efficiency membranes



Decrease the withdrawal of non-renewable water by **90%** and the cost of water production **by 50% by 2035** (II/II)



### Mission motivation

**The Kingdom of Saudi Arabia, the 8th most water-stressed country globally, faces rapidly depleting non-renewable groundwater reserves.** Currently, 60% of KSA's urban water supply comes from desalination, which is not efficient in terms of energy and cost. With national projects like planting 10 Bn trees and increasing food security, demand for water will only grow. This mission aims to achieve carbon circular and low-cost desalination, ensure sustainable exploitation of water resources, increase the efficiency of distribution and storage networks, and optimize water demand across sectors.

### Potential research areas (non-exhaustive)

#### Optimize water demand from municipal, industrial & agri. sectors

- Treatment of dam water
- Innovative intake from dams to minimize suspended solids
- Separation of brown and gray water
- Wastewater effluent reuse in industry and agriculture
- Industry specific AI-enabled wastewater treatment solutions
- Water saving pipes & irrigation system
- Drought resistant plant varieties
- Smart water meters & IoT
- Next-generation bathroom & house appliances
- Innovative methods to reduce water consumptions for different applications

#### Expand coverage and efficiency of wastewater collection and treatment

- Microbial & Contaminant Testing
- Energy neutral waste water treatment
- Centralized vs noncentralized WWT systems
- Energy positive sewage treatment plants
- Epidemiological wastewater surveillance
- Sludge treatment, recycling & disposal
- Alternative disinfection methods

#### Data collection and optimization

- Innovating means for automated IWRM in the kingdom
- Innovating tools using IoT solutions to measure the enforcement of water laws
- Cyber security of desalination plants
- Drought forecast

#### Water Policy and governance

- Waste in water systems waste source identification
- Socioeconomics and governance of ground water and ground water exploitation economics
- Monitor water quality standards, management and enforcement
- Implication of climate change on water demand and consumption.
- Water accounting: Water economic and technical
- valuation, value maximization for different sectors
- Risk assessment
- Develop a National water research model and optimize holistically
- Enhance the efficiency of water management organizations
- Incentive-based policy instruments and water use efficiency

#### Sustainable Desalination

- Renewable seawater and brackish water desalination
- Water energy nexus

Achieve **net-zero** emissions **by 2060**



### Mission motivation

**The Kingdom of Saudi Arabia aims to achieve net-zero emissions by 2060 through the Carbon Circular Economy approach.** This mission addresses the Kingdom's leading role in confronting global climate challenges and underscores the necessity of clean transformation for socio-economic prosperity. Key areas of focus include energy demand management, clean mobility and transportation, clean energy generation, alternative fuels, and carbon technologies. Innovations in energy-efficient buildings, heating and cooling systems, and advanced renewable energy sources are critical to this mission.

### Potential research areas (non-exhaustive)

<b>Energy demand management</b>	<ul style="list-style-type: none"> <li>• Energy Efficient Buildings controlling energy loss and reducing energy needs</li> <li>• Efficient Heating/Cooling especially in industrial uses</li> <li>• Construction Tech with more sustainable production processes reducing Co2</li> </ul>	<ul style="list-style-type: none"> <li>• New generation energy recovery devices with efficiency of over 98%</li> <li>• Simulation aided demand estimation</li> <li>• Efficient AC technologies incl. AI</li> <li>• Ops exc, customer exp., supply and interconnectivity</li> </ul>
<b>Clean mobility and transportation</b>	<ul style="list-style-type: none"> <li>• Electricized transportations (Aviation, Maritime, Road Industry, Vehicles)</li> <li>• Shared mobility platforms and micro mobility</li> <li>• Autonomous vehicles and fuel</li> </ul>	<ul style="list-style-type: none"> <li>• Cell Electric Vehicles</li> <li>• Underground waste network</li> <li>• Transport route optimization</li> <li>• H2-Internal Combustion Engines (H2ICE) Vehicles</li> <li>• Advanced IC engines</li> </ul>
<b>Clean Energy generation</b>	<ul style="list-style-type: none"> <li>• Wind energy generation</li> <li>• Ocean &amp; Hydro energy generation</li> <li>• Solar energy generation</li> <li>• Nuclear energy generation (fission based)</li> </ul>	<ul style="list-style-type: none"> <li>• Geothermal energy generation</li> <li>• Waste/Biomass energy generation</li> <li>• Oxyfuel combustion energy generation</li> </ul>
<b>Alternative Fuels</b>	<ul style="list-style-type: none"> <li>• Biofuels</li> <li>• Develop cold fusion based power generation reactors operated on substances extracted from seawater brine – for example rubidium</li> </ul>	<ul style="list-style-type: none"> <li>• Clean Ammonia</li> <li>• Clean hydrogen</li> <li>• Co2 to Fuels (Kerosene, methanol)</li> <li>• New hydrogen carriers</li> <li>• Neoplastic</li> </ul>
<b>Carbon Tech</b>	<ul style="list-style-type: none"> <li>• GHG monitoring and CCS, including Onboard capture and HVAC</li> <li>• CCU based Carbon neutral chemicals (eMethanol, Blue Polymers etc.)</li> <li>• Artificial coastal lagoons and deep saline aquifers for carbon sequestration</li> <li>• Use of captured carbon for post-treatment of water instead of</li> </ul>	<ul style="list-style-type: none"> <li>• carbonates</li> <li>• Allam Cycle (Supercritical CO2) and CO2 as refrigerant</li> <li>• Chemical looping</li> <li>• AI driven CCU (optimization, storage site identification...)</li> <li>• Enhanced oil recovery (EOR) through CO2 cyclic injection</li> <li>• Recycling and reuse of emissions</li> </ul>



Protect **30%** of the Kingdom's land and sea **by 2035**



### Mission motivation

**The threat of global biodiversity decline necessitates immediate action.** The UN has set a goal to protect 30% of the world's land and sea by 2030, and KSA is committed to this target. KSA is home to about 6,000 species, with 111 threatened and 75% of its mangroves lost between 1985 and 2013. This mission includes surveillance and monitoring, biodiversity management, scientific research, and controlled human-wildlife interactions. Efforts will focus on protecting natural ecosystems, leveraging technology for ecosystem management, and fostering global scientific collaborations.

### Potential research areas (non-exhaustive)

<b>Surveillance and monitoring</b>	<ul style="list-style-type: none"> <li>• AI based incident mapping and reporting systems</li> <li>• Poaching, fishing and logging sensor networks</li> <li>• Satellite emergency messaging devices and systems</li> <li>• Habitat change monitoring</li> </ul>	<ul style="list-style-type: none"> <li>• through drone technology</li> <li>• Acoustic sensor networks</li> <li>• Flash flood and environmental disasters protection (against heavy rainfall, sandstorm, floods, roughs)</li> </ul>
<b>Biodiversity management</b>	<ul style="list-style-type: none"> <li>• Ecosystem management technologies</li> <li>• Image recognition AI based species identification</li> <li>• Connected camera traps and security cameras</li> <li>• Invasive species monitoring</li> </ul>	<ul style="list-style-type: none"> <li>• through</li> <li>• drone technology</li> <li>• Open-source scientific collaboration platforms</li> <li>• Blockchain wildlife monitoring data</li> </ul>
<b>Scientific research</b>	<ul style="list-style-type: none"> <li>• Automated biodata collection</li> <li>• Automated ecological monitoring</li> <li>• VR based conservation footage for scientific collaborations</li> <li>• Habitats monitoring software</li> </ul>	<ul style="list-style-type: none"> <li>• analysis ecosystem temperature and other parameters</li> <li>• Population tracking through sensors and GPS systems</li> </ul>
<b>Controlled human-wildlife interactions</b>	<ul style="list-style-type: none"> <li>• Automated animal deterrents to reduce human-wildlife conflicts related to habitats and cattle attacks</li> <li>• Communications and collaboration between the various park stakeholders</li> </ul>	<ul style="list-style-type: none"> <li>• VR wildlife experience to safely experience interactions with wildlife at minimal risks and impact and on wildlife</li> <li>• Mitigation of air pollution</li> <li>• Waste utilization</li> </ul>

## Develop and Adopt Innovative Cooling Technologies to Reduce Cooling Electricity Consumption **by 30% by 2040**



### Mission motivation

**Air conditioning is crucial in the Kingdom of Saudi Arabia, the third-largest consumer of electricity for cooling globally**, with 70% of its energy consumption dedicated to air conditioning. This mission addresses the need for efficient cooling solutions to reduce CO2 emissions. Key areas of focus include sustainable refrigerants, advanced evaporative cooling technologies, enhanced building insulation, and smart thermostats. The adoption of district cooling systems and night sky cooling leveraging space's cold are innovative solutions that align with KSA's net-zero 2060 goals.

### Potential research areas (non-exhaustive)

<b>Refrigerant Cooling alternative</b>	<ul style="list-style-type: none"> <li>Fuel cell cooling</li> <li>Sustainable refrigerant in vapor compression systems</li> <li>Coherent laser radiation</li> <li>Nano photonics and metamaterials</li> <li>Peltier elements (heat pumps transferring heat based on</li> </ul>	<ul style="list-style-type: none"> <li>electrical current direction)</li> <li>Elastic nickle-titanium wires</li> <li>Organic solid crystals to replace refrigerants</li> <li>Advanced evaporative cooling technology</li> </ul>
<b>Heat-cold preservation methods</b>	<ul style="list-style-type: none"> <li>Enhanced building insulation to reduce energy losses</li> <li>Smart windows that harvest/reflect energy</li> <li>Controlled phase-change photonics</li> <li>Self-tinting and app-controlled</li> </ul>	<ul style="list-style-type: none"> <li>windows</li> <li>Smart responsive window systems</li> <li>Fluid cooling panels as low-energy technology</li> </ul>
<b>Intelligent control systems</b>	<ul style="list-style-type: none"> <li>Smart thermostats for energy management systems</li> <li>Smart material that absorbs moisture</li> <li>AI-based thermostats</li> </ul>	<ul style="list-style-type: none"> <li>compatible with all HVAC systems</li> <li>Intelligent personalized climate and lighting control</li> </ul>
<b>Urban cooling technologies</b>	<ul style="list-style-type: none"> <li>District cooling system distributing central cooling capacity to multiple buildings</li> <li>Night sky cooling leveraging the cold of space</li> <li>Capturing geothermal cold temperatures to cool buildings</li> </ul>	<ul style="list-style-type: none"> <li>while sending heat down below earth</li> <li>Microturbines powered by solar energy</li> <li>Water, cooling, and energy production from waste heat</li> </ul>
<b>Implement renewable energy for cooling</b>	<ul style="list-style-type: none"> <li>Solar, wind and geothermal for cooling</li> </ul>	

Develop technologies in food for sustainable and resilient food systems to achieve more than **50%** self-sufficiency **by 2040**



### Mission motivation

**The GCC countries, including KSA, import 85% of their food, and KSA ranks 44th on the Global Food Security Index for 2021**, the lowest among GCC countries. Water scarcity and extreme heat make only 1.6% of the country arable, exacerbated by small farm sizes and high food waste. This mission focuses on leveraging KSA's long coastline to boost aquaculture and enhance sustainable farming practices. Key goals include improving farming productivity, managing resources sustainably, and developing new farming paradigms through advanced agricultural technology.

### Potential research areas (non-exhaustive)

<b>Farming productivity improvements</b>	<ul style="list-style-type: none"> <li>• Water quality monitoring</li> <li>• Fish Diagnosis</li> <li>• Feed Inventory Management</li> <li>• Livestock Farm Intelligence</li> <li>• Robotic Milking Systems</li> <li>• Milk Preservation and production Optimization</li> </ul>	<ul style="list-style-type: none"> <li>• Robots for Poultry farming</li> <li>• Livestock hygiene and waste management</li> <li>• Implementation of innovative fertilization methods</li> <li>• Magnetic methods to improve productivity</li> </ul>
<b>Sustainable resource management</b>	<ul style="list-style-type: none"> <li>• Soil health, fertility, irrigation, nutrients, soil microbiome</li> <li>• Traceability and Food Safety</li> <li>• Disease and diagnostics (plant and animal)</li> <li>• Animal health, and related One Health, health management</li> <li>• Food Innovative Ingredients</li> </ul>	<ul style="list-style-type: none"> <li>• and Sustainable feeds</li> <li>• Regenerative and Sustainable farming</li> <li>• Water desalination and footprint management</li> <li>• Bioreactors</li> <li>• Waste food recycling program</li> </ul>
<b>New farming paradigms</b>	<ul style="list-style-type: none"> <li>• New farming models (Indoor, Vertical, Greenhouse, Ocean, Smart)</li> <li>• Smart farming capsules</li> <li>• Recirculating Aquaculture</li> <li>• Hydroponics/Aquaponics/Aeroponics</li> </ul>	<ul style="list-style-type: none"> <li>• Plant based proteins/carbohydrates</li> <li>• New production methods for Proteins/Sugars (Algae, Yeast fermentation, Enzyme tech, lab grown)</li> </ul>
<b>Agricultural technology</b>	<ul style="list-style-type: none"> <li>• Farm Monitoring and smart farming applications</li> <li>• AI-enabled autonomous farming</li> <li>• Farm analytics</li> <li>• Precision agriculture</li> </ul>	<ul style="list-style-type: none"> <li>• Farming-as-a-service</li> <li>• Post harvest management</li> <li>• Tractor Solutions</li> <li>• IT solutions to network farmers with distributors and consumers</li> </ul>
<b>Recovery and recycling</b>	<ul style="list-style-type: none"> <li>• Food recovery solutions</li> <li>• Food recycling Programs</li> <li>• Food Inventory Management</li> <li>• Food Rescue–Excess Food Management</li> <li>• AI based food preservation</li> </ul>	<ul style="list-style-type: none"> <li>• Alternative Protein From Food Waste</li> <li>• Surplus food management platform</li> <li>• Circular Economy</li> <li>• Harvester Technology</li> </ul>



## Plant **10 Billion** Trees Across KSA **by 2040**



### Mission motivation

#### **Global warming and climate change are two of KSA's most challenging problems.**

Rising temperatures and longer, more frequent droughts are putting a strain on water supplies and food production, particularly in countries like the Kingdom of Saudi Arabia, which has one of the warmest climates on the planet. Planting trees can help address the issue. Some trees such as the saxaul tree can survive for months without a drop of water and thrive in particularly harsh environments. Significantly more trees – including multiple species – would support food security and summer temperature reduction.

### Potential research areas (non-exhaustive)

<b>Reforestation/ Seed Planting</b>	<ul style="list-style-type: none"> <li>• Protect existing forests and use natural forest regrowth and historical grounds whenever possible</li> <li>• AI-enabled restoration and reforestation services</li> <li>• Genetic modified seedlings providers</li> </ul>	<ul style="list-style-type: none"> <li>• Drone based plantation</li> <li>• Post planting maintenance technologies (robots, drones, sensors...)</li> <li>• Smart irrigation</li> <li>• Mangrove tree forestation</li> <li>• Salinity tolerant plants</li> </ul>
<b>Tree Health</b>	<ul style="list-style-type: none"> <li>• Cross breeding tree species for resilience (to changing climate, salt water, droughts..) and adaptation</li> <li>• Involve private sector and local communities in forest management and value creation</li> </ul>	<ul style="list-style-type: none"> <li>• Control biodiversity to maximize it while reducing impact on human populations</li> <li>• Develop tree varieties that can feed on sea water</li> <li>• Fertilization methods</li> </ul>
<b>Fire Detection &amp; Control</b>	<ul style="list-style-type: none"> <li>• Connected fire sensors, cameras, communication</li> <li>• Satellite imagery to detect wildfires including</li> </ul>	<ul style="list-style-type: none"> <li>• underground fires</li> <li>• Fire control (laser based, sound based, drones based)</li> </ul>
<b>Data Analytics</b>	<ul style="list-style-type: none"> <li>• Forest planning and maintenance models</li> <li>• Protection from invasions etc.</li> <li>• Forest intelligence through AI</li> <li>• Environmental impact assessment</li> <li>• Forestry data and reports</li> </ul>	<ul style="list-style-type: none"> <li>• Carbon absorption sensors</li> <li>• Remote water provision and utilization efficiency</li> <li>• Implementation of smart blue prints to minimize land area</li> </ul>
<b>Data Analytics</b>	<ul style="list-style-type: none"> <li>• Energy passive technologies for atmospheric water generation to water trees</li> <li>• Mapping &amp; surveillance systems</li> <li>• Illegal drug, farming and logging Detection</li> <li>• Drone based surveillance</li> </ul>	<ul style="list-style-type: none"> <li>• Tree monitoring for pest, structural stability etc. ...</li> <li>• Assisting soil water retention with utilizing water adsorbents or water evaporation limiting agents</li> </ul>

## Reduce Summer Surface Temperatures by **4°C by 2040**



### Mission motivation

**Thermal conditions are an urgent concern in cities around the world that must contend with increasingly extreme and inequitable heat impacts.** Regional climate science has unequivocally established the connection between urban land features such as buildings and roads and hotter land surface temperature in cities. The Kingdom of Saudi Arabia's capital sits on a desert plateau and can reach temperatures exceeding 50°C during the summer. This mission goes hand in hand with the net zero strategy and is enabled by the decrease in the reduction in non-renewable water use and tree planting missions.

### Potential research areas (non-exhaustive)

<b>Surface heat analysis and forecasting</b>	<ul style="list-style-type: none"> <li>• Sensor infrared technologies equipped drones for hotspot identification</li> <li>• Large scale simulations of heat hotspots and temperatures to</li> </ul>	<ul style="list-style-type: none"> <li>• anticipate issues and evaluate the impact of identified initiatives</li> <li>• Other innovations</li> </ul>
<b>Urban vegetation management</b>	<ul style="list-style-type: none"> <li>• Soil composition analysis to promote soil living ecosystems leading to cooler temperatures</li> <li>• Trees and shrub coverage in and around the city for shade and heat absorption</li> <li>• Green roofs to further increase</li> </ul>	<ul style="list-style-type: none"> <li>• the vegetation coverage in the city</li> <li>• Green belts around major cities and areas of increased ambient temperatures</li> </ul>
<b>Urban infrastructure planning</b>	<ul style="list-style-type: none"> <li>• Urban planning enabling air flows and heat reduction plans</li> <li>• Pavements with heat resistant materials</li> <li>• Reflective paints and coatings</li> <li>• Irrigation networks for recycled water throughout the city</li> </ul>	<ul style="list-style-type: none"> <li>• Reflective or cool roofs</li> <li>• Energy efficient appliances and equipment generating less heat</li> <li>• Appliances usage reduction to reduce heat generation</li> </ul>
<b>Heat transfer technologies</b>	<ul style="list-style-type: none"> <li>• Reflective low-cost materials to shade large areas</li> <li>• Adiabatic cooling transfers</li> <li>• Heat pumps transferring heat away from urban areas</li> </ul>	<ul style="list-style-type: none"> <li>• Energy production from waste heat</li> <li>• Seeded rain quality monitoring for sustainability</li> </ul>
<b>Develop technologies to reduce surface temperature</b>	<ul style="list-style-type: none"> <li>• Active or Passive technologies for large scale</li> </ul>	

# 04

## ***FUNCTIONAL INTERVENTIONS FOR RDI IN SUSTAINABILITY AND ESSENTIAL NEEDS***

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**In the Kingdom of Saudi Arabia, the advancement of RDI is underpinned by 5 crucial enablers** which are essential for creating a robust and dynamic RDI ecosystem. The RDI policy in KSA provides cohesive direction to improve on these enablers in tandem, ensuring that the overall RDI posture of the Kingdom can advance effectively and sustainably. By addressing each enabler comprehensively, KSA aims to foster innovation, enhance environmental sustainability, and establish itself as a global leader in sustainability and essential needs. **Funding and Investments** ensure that adequate financial resources are available to support groundbreaking research and development projects. **Human Capital** focuses on developing a skilled workforce capable of driving advancements in sustainability and essential needs solutions. **The regulatory landscape** creates a conducive environment for innovation by establishing clear guidelines and standards. **Ecosystem Infrastructure and Supply Chain** facilitate the efficient delivery of sustainable services and the commercialization of new technologies. **Linkages and Cultural Promotion** emphasize the importance of collaboration and engagement across sectors to drive innovation and improve sustainability outcomes. By enhancing these enablers, KSA is poised to achieve significant progress in its Vision 2030 goals, leveraging RDI to address critical challenges and promote overall well-being through sustainable development.

**Figure 12: Key enablers for fostering and supporting RDI in Sustainability and Essential Needs**



### **Funding & investments**

**Adequate funding and strategic investments** are crucial for fostering innovation, supporting groundbreaking projects, and driving sustainable development. Financial backing is necessary to advance research and development in areas such as renewable energy, water management, and climate-resilient agriculture.



### **Human Capital**

**Developing a skilled workforce is essential for RDI success in sustainability and essential needs.** By investing in education, training, and upskilling, KSA ensures a robust talent pool capable of driving advancements in sustainable technologies and practices, essential for addressing environmental challenges.



### **Regulatory landscape**

**Effective policies and regulations create a conducive environment for RDI in sustainability and essential needs.** By establishing clear guidelines and standards, the government can promote innovation, ensure environmental protection, and facilitate the smooth implementation of sustainability and essential needs initiatives.



### **Ecosystem, Infrastructure & Supply Chain**

**Well-developed infrastructure and an efficient supply chain are critical for supporting RDI activities in sustainability.** This enabler ensures that researchers have access to state-of-the-art facilities and that innovations in areas like energy efficiency and sustainable agriculture can be quickly and efficiently brought to market.



### **Linkages and Cultural Promotion**

**Building strong connections between various stakeholders and promoting a culture of innovation are vital for RDI success.** By fostering collaboration and engagement across sectors, KSA can drive significant advancements in sustainable development and essential resource management.

## 4.1 FUNDING AND INVESTMENTS

### *Status quo and current efforts*

The Kingdom of Saudi Arabia has significantly boosted its investments in RDI for sustainability and essential needs. The government has allocated substantial funding to support research in areas like water desalination, renewable energy, and environmental conservation. Institutions such as King Abdulaziz City for Science and Technology (KACST) and King Abdullah University of Science and Technology (KAUST) have been at the forefront of these efforts. The National Transformation Program (NTP) and Vision Realization Programs (VRPs) are key drivers of these investments, focusing on sustainable resource management. KSA is working to harness innovation to provide solutions for pressing national and global needs, such as access to a clean water supply and desalination techniques, food production, carbon capture, and the creation of green spaces. The government has pledged to spend \$186 billion on the Kingdom's green economy by 2030.

The Ministry of Environment, Water, and Agriculture (MEWA) is a pivotal player in promoting sustainability RDI. MEWA has implemented various initiatives to support research and development in water management, agricultural sustainability, and environmental protection. The Saudi Water Authority (SWA) focuses its funding on water sustainability projects, supporting research in water conservation and desalination technologies. The Saudi Green Initiative allocates substantial resources to RDI efforts aimed at reducing carbon emissions and promoting renewable energy, aligning with the Kingdom's Vision 2030 sustainability goals. The Ministry of Education (MoE) and King Fahd University of Petroleum and Minerals (KFUPM) are active in funding RDI projects and heavily involved in training and upskilling programs to foster innovation. Water and wastewater projects are progressing rapidly in line with National Transition 2020 and Vision 2030. The Kingdom is also the world leader in desalinated water production with 16.5% of global production.

***Grants offer benefits that extend beyond the Saudi scientific community. The RDI ecosystem*** has the potential to drive economic growth and create new industries, while also addressing crucial societal challenges.

The government has established several grant programs to support high-impact research projects. For instance, the Saudi Basic Science (SBS) initiative and Saudi Applied Research and Technology (SART) offer project-level funding to expand the pool of talented researchers. SART's Technology Development Grant provides funds of up to SAR 10 million over five years, supporting advanced research in sustainability. Additionally, specific grants are planned to be awarded to 20+ science labs focused on sustainability and essential needs across 15 universities (from the pool of SAR 312 million for reactivation of labs in the country). The initiatives also aim to activate and enhance the participation of local researchers in areas that will lead to the next generation of breakthroughs. The SBS initiative is divided into 3 specific tracks: Young Scholars Grant (YSG), Basic Science Grant (BSG), and Research Consortium Grant (RCG). The Technology Development Startup innovation grant (SBIR) is a government program providing non-dilutive funding to stimulate RDI in startups and SMEs that is linked to demand challenges.

***Institutional funding is a significant component of KSA's RDI expenditure in sustainability and essential needs.*** Notable institutions like King Saud University and King Abdullah University of Science and Technology (KAUST) receive robust support to conduct cutting-edge research. These institutions play a pivotal role in developing innovative solutions for water management, renewable energy, and environmental conservation. The focus on institutional funding has enabled the establishment of state-of-the-art research facilities and fostered international collaborations.




RDIA and MEWA are spearheading significant funding initiatives aimed at advancing RDI in sustainability and essential needs. They have allocated a total of SAR 3 billion, including SAR 1.2 billion of institutional funding. This supports critical areas such as groundwater management, water cost reduction, and self-sufficiency in agriculture. Initiatives include projects like irrigation and water management, renewable energy integration, and alternative animal feed sources. RDIA and MEWA are also implementing a performance-based funding framework to ensure effective deployment and continuous progress monitoring from 2024 to 2030. This strategic approach underscores their commitment to fostering innovation and building resilient, sustainable systems to meet future challenges.

KSA's private sector has shown a growing interest in RDI for sustainability. Major corporations such as Saudi Aramco and SABIC have made substantial investments in research and development to address sustainability challenges. These companies focus on developing technologies for renewable energy, water desalination, and environmental protection. Their efforts are complemented by strategic partnerships with academic institutions and government agencies, fostering a collaborative approach to innovation.

Venture capital investments in KSA have seen significant growth, particularly in the sustainability sector. In 2023, venture capital funding reached approximately SAR 1.38 billion, with a considerable portion directed towards sustainability-focused startups. Major VC funds such as Wa'ed Ventures and the Saudi Venture Capital Company (SVC) have financed startups working on innovative solutions in water technology, renewable energy, and sustainable agriculture. These investments are crucial for driving the development of cutting-edge technologies and fostering a dynamic entrepreneurial ecosystem.

The country's entrepreneurial ecosystem has experienced considerable growth, with a vibrant community of startups dedicated to sustainability and essential needs. Out of the ~2,000 active startups in the Kingdom, 180+ are focused on sustainability. Notable examples include Lyris, an agritech startup pioneering innovative solutions to address global food security challenges while minimizing environmental impact. It has raised \$50+ million in funding to-date. NOMADD, which develops automated cleaning systems for solar panels, and Desert Control, which works on innovative solutions to combat desertification are two other startups that benefit from a supportive environment including incubators, accelerators, and funding opportunities.

**Figure 13: Examples of successful KSA-based start-ups pioneering innovation in sustainability and essential needs**

			
	<b>NOMADD</b>	<b>DESERT CONTROL</b>	<b>LYRIS</b>
<b>Description</b>	Startup that focuses on developing an automated cleaning system for solar panels, a crucial technology in desert environments where dust accumulation on solar panels can significantly reduce efficiency	Company develops a technology called Liquid NanoClay, which helps turn desert land into fertile soil by enhancing its water retention capacity, particularly significant for KSA's fight against desertification	Agri-tech startup that develops innovative solutions for global food security while minimizing environmental impact by working on precision agriculture technologies that optimize resource use
<b>Funding received</b>	<b>SAR 28M</b> raised over multiple rounds of seed and series funding	<b>~ SAR 30M</b> Raised over multiple funding rounds	<b>~ SAR 50M</b> raised to date from a combination of government grants and VC funding



The Kingdom of Saudi Arabia's strategic focus on enhancing RDI in sustainability and essential needs has led to significant advancements. With robust government support, substantial private sector investments, and a thriving entrepreneurial ecosystem, the Kingdom is well-positioned to continue its progress in sustainability research and innovation. These efforts are aligned with Vision 2030 goals, aiming to ensure sustainable development and address critical environmental challenges. The collaborative approach between government agencies, academic institutions, and the private sector is fostering a dynamic RDI landscape, contributing to the overall well-being of the Kingdom and its citizens.

## ***Outlook for funding and investments***

As KSA continues its ambitious journey towards achieving Vision 2030, the focus on RDI in sustainability and essential needs becomes ever more critical. Recognizing the importance of sustainable development, the Kingdom is set to amplify its efforts by ensuring robust funding, strategic investments, and supportive policies for RDI. The following section outlines the Kingdom's strategic plans to enhance government funding, foster public-private partnerships, increase venture capital and private investments, develop sustainable funding models, encourage global collaboration, introduce innovative financial instruments, and provide a policy framework that supports these initiatives.

### ***Expansion of government funding programs***

KSA is set to enhance its funding landscape by expanding existing programs and launching new initiatives aimed at supporting RDI in sustainability and essential needs. The government plans to significantly boost its budget for sustainability-related research, with additional funds allocated to key institutions like King Abdulaziz City for Science and Technology (KACST) and King Abdullah University of Science and Technology (KAUST). New grant programs will be introduced targeting emerging areas of sustainability such as advanced materials for renewable energy, innovative water purification technologies, and carbon capture methods. These programs will focus on both basic and applied research, fostering a comprehensive RDI environment. Policies will support the development of these grants with streamlined application processes and transparent evaluation criteria.

### ***Strategic Public-Private partnerships***

KSA plans to strengthen its international collaborations to enhance the quality and impact of its human capital in sustainability RDI. The Kingdom will form new partnerships with leading international research institutions. Joint research programs will be established, allowing Saudi researchers to work alongside global experts on cutting-edge sustainability projects. Policy frameworks will facilitate these collaborations by providing guidelines on intellectual property, funding mechanisms, and mutual recognition of research outcomes. Public-private partnerships will be fostered through joint ventures between government bodies and leading corporations like Saudi Aramco and SABIC to develop and deploy cutting-edge technologies in renewable energy and water management.

### ***Enhanced venture capital and private investments***

To foster innovation and encourage private sector participation, KSA will introduce several new incentives and policy mechanisms. Increasing the availability of venture capital through funds like Wa'ed Ventures and Saudi Venture Capital Company (SVC) will specifically target startups focused on sustainability and essential needs. Policies will provide clear guidelines and frameworks to ensure mutual benefits and streamlined operations, fostering a collaborative innovation ecosystem. Offering tax incentives, grants, and other financial benefits to encourage private investments in sustainability-focused RDI projects will attract both domestic and international investors to the Kingdom.

***Focus on long-term sustainable funding models***

The government is committed to ensuring the sustainability of funding through long-term financial models and mechanisms. Endowment funds will be established to provide a steady stream of income for sustainability research projects. Performance-based funding frameworks will be implemented to ensure efficient use of resources, with policies supporting regular monitoring and evaluation of funded projects to ensure they meet predefined milestones and objectives. Introduction of policy measures to support long-term funding, including legislations that guarantee the continuity of funding programs and incentives for performance excellence, will be emphasized.

***Global collaboration and funding***

The Kingdom will secure international grants and form partnerships with leading global institutions and research bodies. This will not only bring additional funds but also enhance the quality and impact of research through collaborative efforts. Global collaboration agreements will be established to promote joint RDI initiatives in sustainability. These agreements will outline collaborative frameworks, funding mechanisms, and intellectual property rights to ensure effective international cooperation.

***Development of green financial instruments***

Innovative financial instruments will be developed to support sustainable investments. Policies will support the development and adoption of green financial instruments, including legal frameworks, market incentives, and reporting standards. Issuance of green bonds and sukuks will raise capital specifically for sustainability projects, appealing to environmentally-conscious investors and providing a reliable funding source for large-scale initiatives. Sustainability-linked loans will be introduced, where interest rates are tied to the achievement of specific environmental goals, encouraging borrowers to meet sustainability targets.

## 4.2 HUMAN CAPITAL

### *Status quo and current efforts*

Human capital is a cornerstone of RDI in the sustainability and essential needs sector, and the Kingdom of Saudi Arabia has made substantial efforts to cultivate a skilled workforce. According to the latest data, there are over 10,500 active researchers contributing to this field.

KSA has introduced several initiatives to attract and retain top global talent in sustainability RDI. The Premium Residency Program offers long-term residency options for highly skilled international researchers, facilitating their ability to live and work in KSA. To draw high-caliber researchers and support staff, the Kingdom offers competitive compensation packages, including benefits that are on par with international standards. Additionally, the visa process for researchers has been simplified to ensure a smooth and efficient application process, making it easier for international talent to relocate to the Kingdom.

Scholarships play a crucial role in developing local talent and supporting advanced education in sustainability. The King Abdullah Scholarship Program (KASP) provides scholarships for Saudi students to pursue higher education at top global universities, with a focus on sustainability-related fields. Institutions like King Abdulaziz City for Science and Technology (KACST) and King Abdullah University of Science and Technology (KAUST) offer specific scholarships for students pursuing degrees in environmental science, renewable energy, and water management. These scholarships include the KAUST Fellowship, which covers tuition fees, housing, and provides a living stipend, and the KACST Research Scholarship, which supports research projects in areas of sustainability.

The development of human capital in sustainability and essential needs is supported by several key institutions and programs. The Digital Government Authority conducts digital upskilling of government employees to support the adoption of technology solutions, enhancing the overall capability of the workforce. The KACST Innovation Center provides a collaborative environment for researchers to develop and commercialize innovative sustainability solutions. Furthermore, King Fahd University of Petroleum and Minerals (KFUPM) offers specialized training programs and courses focused on sustainability and environmental management, ensuring that graduates are well-prepared to tackle contemporary challenges in these fields.

KSA has invested significantly in building state-of-the-art educational and research infrastructure to support sustainability RDI. Advanced labs equipped with cutting-edge technology enable high-quality research and innovation. For example, the National Center for Water Research and Studies at KACST focuses on water desalination technologies, while the Renewable Energy Research Institute at KAUST is dedicated to advancing solar and wind energy solutions. Innovation centers, such as the KACST Innovation Center, facilitate collaboration and the development of new sustainability solutions by providing access to resources and support for prototyping and testing.

Through targeted upskilling, and talent attraction initiatives, KSA is building a strong foundation of human capital in the sustainability and essential needs sector. Training programs are in place to continuously develop the skills of the workforce. For instance, the Saudi Green Building Forum offers certification programs for professionals in sustainable building practices. Competitive benefits and streamlined processes help attract global expertise, such as offering expedited visa services and attractive relocation packages for international researchers. Substantial investments in educational and research infrastructure, such as the establishment of the Advanced Manufacturing Institute at KFUPM, ensure the resources needed to support cutting-edge R&D.

These efforts highlight the Kingdom's commitment to driving innovation and ensuring sustainable development. By fostering a skilled workforce dedicated to advancing sustainability, KSA is well-positioned to continue its progress in this critical sector.



**Figure 14: KSA has shown significant progress across multiple RDI metrics**



## Outlook for human capital

The Kingdom is poised to implement a range of strategic initiatives designed to attract, develop, and retain top talent in this sector. This section encompasses comprehensive plans to expand educational opportunities, enhance training programs, foster international collaborations, create an environment conducive to groundbreaking research and innovation, and establish supportive policy frameworks.

### Expansion of educational opportunities

KSA plans to significantly expand its educational initiatives to cultivate a highly skilled workforce in sustainability and essential needs. The government aims to double the number of scholarships offered through programs like the King Abdullah Scholarship Program (KASP) and the KAUST Fellowship. New scholarships will also be introduced, targeting emerging fields within sustainability, such as circular economy practices and advanced biotechnologies. These efforts will be supported by policy directives ensuring sustained funding and streamlined administration of scholarship programs. Universities will develop new specialized degree programs focused on critical areas such as climate change mitigation, sustainable urban planning, and environmental policy. These programs will be designed in collaboration with international universities to ensure they meet global standards, with policies enacted to facilitate these international partnerships and ensure accreditation.

### Enhancement of training and upskilling programs

To ensure continuous development of the workforce, KSA will enhance its training and upskilling initiatives. The Digital Government Authority will expand its digital upskilling programs to include training in green technologies and sustainable practices. This will prepare government employees and the wider workforce for the integration of sustainable solutions in their roles. Policy measures will mandate the integration of such training into the curriculum of public sector development programs. New research training centers will be established, focusing on advanced methodologies in sustainability research. These centers will offer hands-on training in state-of-the-art facilities, covering topics such as renewable energy systems, water resource management, and sustainable agriculture. Policies will support the creation and funding of these centers, ensuring their alignment with national RDI priorities.

Source: 1, 2: RDIA and Elsevier publication on "Saudi Arabia's Leap in Research and Development Excellence" (2023); 3. MagniTT database

### ***Fostering international collaborations***

KSA plans to strengthen its international collaborations to enhance the quality and impact of its human capital in sustainability RDI. The Kingdom will form new partnerships with leading international research institutions. Joint research programs will be established, allowing Saudi researchers to work alongside global experts on cutting-edge sustainability projects. Policy frameworks will facilitate these collaborations by providing guidelines on intellectual property, funding mechanisms, and mutual recognition of research outcomes. This exposure to international best practices will enhance their expertise and contribute to the global exchange of knowledge.

### ***Creating a conducive research environment***

KSA is committed to creating an environment that supports and stimulates groundbreaking research and innovation. The establishment of new innovation hubs and incubators will be prioritized. These centers will provide resources and support for startups and researchers to develop and commercialize innovative sustainability solutions. Policy initiatives will include funding support, tax incentives, and regulatory frameworks that encourage the establishment and operation of these hubs. Significant investments will be made to upgrade existing research facilities and build new ones. This includes equipping laboratories with the latest technologies and creating collaborative spaces that encourage interdisciplinary research. Policies will ensure the allocation of resources and provide governance structures to maintain high standards of research infrastructure.

### ***Incentivizing talent attraction and retention***

To attract and retain top talent, KSA will implement several strategic initiatives. The government will ensure that compensation packages for researchers are highly competitive, including comprehensive benefits and performance-based incentives. Further streamlining of immigration processes will be undertaken to facilitate the quick and efficient entry of international researchers and their families. This includes the expansion of the Premium Residency Program to cover more categories of skilled professionals. Policies will support this by simplifying visa regulations and providing clear pathways for residency. Comprehensive career development programs will be introduced, providing researchers with clear career progression paths, opportunities for professional growth, and access to continuous learning resources. Policy measures will ensure these programs are integrated into institutional frameworks and funded appropriately.

### ***Commitment to diversity and inclusion***

Recognizing the importance of a diverse workforce, KSA will emphasize diversity and inclusion in its human capital strategy. Initiatives will be launched to support and encourage women to pursue careers in STEM fields related to sustainability. This includes scholarships, mentorship programs, and dedicated research grants. Policies will be developed to ensure an inclusive work environment that respects and values diversity. This includes training programs on diversity and inclusion and support networks for underrepresented groups.

By focusing on these strategic areas and supporting them with the appropriate policies, KSA aims to build a robust and dynamic human capital ecosystem that will drive its RDI efforts in sustainability and essential needs.

## 4.3 REGULATORY LANDSCAPE

### *Status quo and current efforts*

The Kingdom of Saudi Arabia has recently introduced several key regulations to strengthen the sustainability and essential needs RDI ecosystem. The National Water Strategy and the Environmental Protection Law are pivotal frameworks designed to foster innovation in water management and environmental conservation. They help to create a conducive environment for research and development by providing clear guidelines and incentives for innovation.

The Kingdom continuously refines its policies to support RDI activities in sustainability. The National Transformation Program (NTP) and the Vision 2030 initiative provide a strategic framework to enhance RDI capabilities across various sectors, including water, food, and energy. These programs outline strategies to diversify the economy, promote sustainable development, and ensure the efficient use of resources.

Several governmental agencies and regulatory bodies facilitate RDI in KSA. The Ministry of Environment, Water, and Agriculture (MEWA) promotes sustainability RDI through policies and grants for research projects. The Saudi Food and Drug Authority (SFDA) plays a critical role in regulating agricultural and environmental products, ensuring safety and efficacy. The King Abdulaziz City for Science and Technology (KACST) supports scientific research and innovation through funding and infrastructure development.

The RDI Authority (RDIA) is at the forefront of coordinating national RDI efforts, setting strategic priorities, and facilitating partnerships. RDIA's efforts include establishing joint research programs and funding consortia that bring together multiple stakeholders to work on high-impact sustainability projects. These initiatives encourage the sharing of knowledge and resources, leading to innovative solutions for the Kingdom's sustainability challenges.

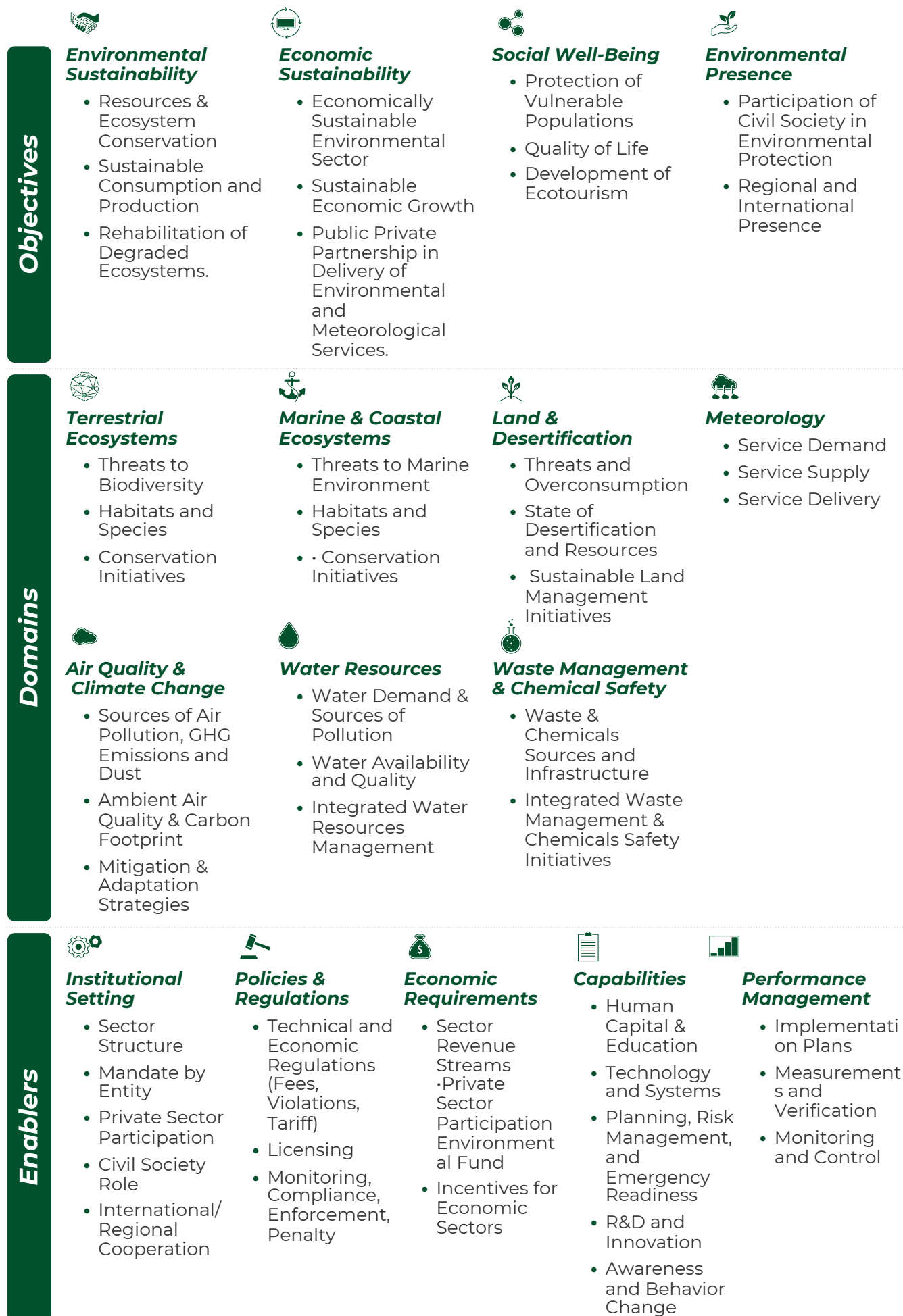
Policy initiatives like the Premium Residency Program are aimed at attracting and nurturing global research talent. The National Competitiveness Center focuses on improving the ease of doing business, with over 300 reforms launched since 2019. Tax exemptions on R&D export earnings and fees related to participation in exhibitions have also been implemented to encourage private sector participation in sustainability RDI.

Several other incentives and policy mechanisms also encourage private sector participation. These include matching funds to encourage private investments in RDI activities and VAT waivers for RDI-centric services and products. The Local Content and Government Procurement Authority has developed a Local Content Formula to incentivize RDI activities and mandate governmental entities to allocate a minimum budget for R&D tenders.

Regulatory sandboxes have been introduced to facilitate the development and commercialization of new technologies. These sandboxes provide a controlled environment where innovators can test their products and services under relaxed regulatory requirements, helping to accelerate the development process. MEWA is currently planning to launch an initiative to streamline RDI demand-side regulatory sandboxes, which includes reviewing, developing, and amending regulatory frameworks and sandboxes that address the roadblocks facing demand for EWA RDI technologies and solutions, both directly and through advocacy with relevant policymakers. With robust regulations, comprehensive policies, and active involvement of governmental agencies and regulatory bodies, the Kingdom is well-positioned to continue ensuring a resilient and advanced ecosystem for sustainability and essential needs.



**Figure 15: Comprehensive framework of the National Environment Strategy**



## ***Outlook for regulatory landscape***

This section outlines the strategic plans and policy directions aimed at enhancing the RDI ecosystem in the Kingdom of Saudi Arabia.

### ***Strengthening and expanding regulatory frameworks***

KSA plans to further strengthen and expand its regulatory frameworks to support RDI in sustainability and essential needs. The enhanced policy direction will ensure these frameworks are adaptive, comprehensive, and aligned with international standards. The Kingdom will refine the National Water Strategy and Environmental Protection Law to incorporate emerging technologies and practices, setting stricter standards for water management, pollution control, and resource conservation. Policy updates will focus on adaptive regulations that can quickly respond to technological advancements and environmental challenges, ensuring ongoing relevancy and effectiveness. New laws will be introduced to address climate change, mandating reductions in greenhouse gas emissions and promoting the use of renewable energy.

### ***Incentivizing innovation and private sector participation***

To foster innovation and encourage private sector participation, KSA will introduce several new incentives and policy mechanisms. Expansion of tax exemptions and grants for companies investing in RDI for sustainability will include increasing the scope of VAT waivers for RDI-centric services and products and providing matching funds for private investments. Policies will ensure these incentives are accessible and provide clear guidelines on application and qualification processes. Moreover, MEWA is establishing an institutionalized program in collaboration with the sector Deputyships and relevant sister entities with the aim of enabling and facilitating the execution of pilots and demonstration plants for prioritized EWA focus areas through targeted incentivization of, and advocacy with, external entities, and through direct R&I Deputyship procurement.

### ***Streamlining regulatory processes and reducing barriers***

To make the regulatory environment more conducive to innovation, KSA will focus on streamlining regulatory processes and reducing barriers. MEWA is currently launching an initiative to review, develop, and amend regulatory frameworks and sandboxes that address the roadblocks facing demand for EWA RDI technologies and solutions, both directly and through advocacy with relevant policymakers. This initiative will accelerate the commercialization of new technologies by offering relaxed regulatory requirements during the testing phase.

### ***Fostering international collaborations and compliance***

KSA aims to foster international collaborations and ensure compliance with global standards through its policy and regulatory frameworks. Policy directions will focus on harmonization and mutual recognition to facilitate global integration. Aligning national regulations with international standards will facilitate global partnerships and attract foreign investments. This will involve participating in international regulatory forums and adopting best practices from leading RDI nations. Policies will ensure that regulations are compatible with global standards and encourage int'l cooperation.

### ***Enhancing policy support for talent attraction and development***

Recognizing the importance of human capital, KSA will enhance policy support for attracting and developing talent in sustainability RDI. Policy directions will ensure a supportive environment for both local and international talent. Strengthening policies that support the Premium Residency Program and other initiatives aimed at attracting global research talent will include providing competitive benefits, streamlined visa processes, and supportive living conditions for international researchers. Policies will ensure that these programs are well-publicized and easily accessible to global talent.

By focusing on these strategic areas and ensuring supportive policy directions, KSA aims to create a dynamic and resilient RDI ecosystem in sustainability and essential needs. These future-oriented initiatives will align with Vision 2030, ensuring sustainable development and positioning the Kingdom as a leader in global RDI efforts.

## 4.4 ECOSYSTEM INFRASTRUCTURE AND SUPPLY CHAIN

### *Status quo and current efforts*

The Kingdom of Saudi Arabia has made substantial investments in building a robust ecosystem and infrastructure to support sustainability and essential needs RDI. These efforts are pivotal in advancing research and developing innovative solutions.

The Kingdom boasts a range of advanced laboratories dedicated to sustainability research. Institutions like King Abdulaziz City for Science and Technology (KACST) and King Abdullah University of Science and Technology (KAUST) are equipped with state-of-the-art facilities that support high-quality research. These laboratories are conducting cutting-edge research and developing innovative solutions in water desalination, renewable energy, and environmental conservation.

KSA has established several specialized research centers to enhance its RDI capabilities. Notable among these are the Saudi National Institute of Water Research, and the King Fahd University of Petroleum and Minerals (KFUPM).

The Kingdom has developed several technology and science parks to foster innovation and collaboration in sustainability and essential needs. The King Abdullah Economic City (KAEC) is one such hub, offering a conducive environment for research and development activities. These parks provide essential infrastructure, including modern laboratories, office spaces, and collaboration areas, facilitating interdisciplinary research and innovation.

KSA has developed a robust network of incubators and accelerators to support innovation in sustainability. Programs like KAUST's Innovation Fund provide essential resources, mentorship, and funding to early-stage companies. These initiatives offer funding, office space, and access to advanced research facilities, helping startups develop and commercialize their sustainability solutions.

Testing and prototyping are crucial stages in the development of new sustainability technologies. KACST and KAUST provide comprehensive testing and prototyping facilities, enabling researchers to validate their innovations in real-world scenarios. These facilities include advanced simulation labs and pilot plants that ensure the safety and efficacy of new products and processes.

KSA has invested significantly in computational facilities and data centers to support sustainability RDI. The King Abdulaziz City for Science and Technology (KACST) houses high-performance computing resources that facilitate large-scale data analysis and environmental modeling. These computational facilities are vital for processing complex datasets and advancing research in areas such as climate modeling and renewable energy optimization.

In addition to its existing infrastructure, KSA is currently undertaking multiple efforts to strengthen its ecosystem infrastructure and supply chain to support sustainability and essential needs. Key initiatives include large-scale investments in renewable energy, with a focus on solar and wind power projects.

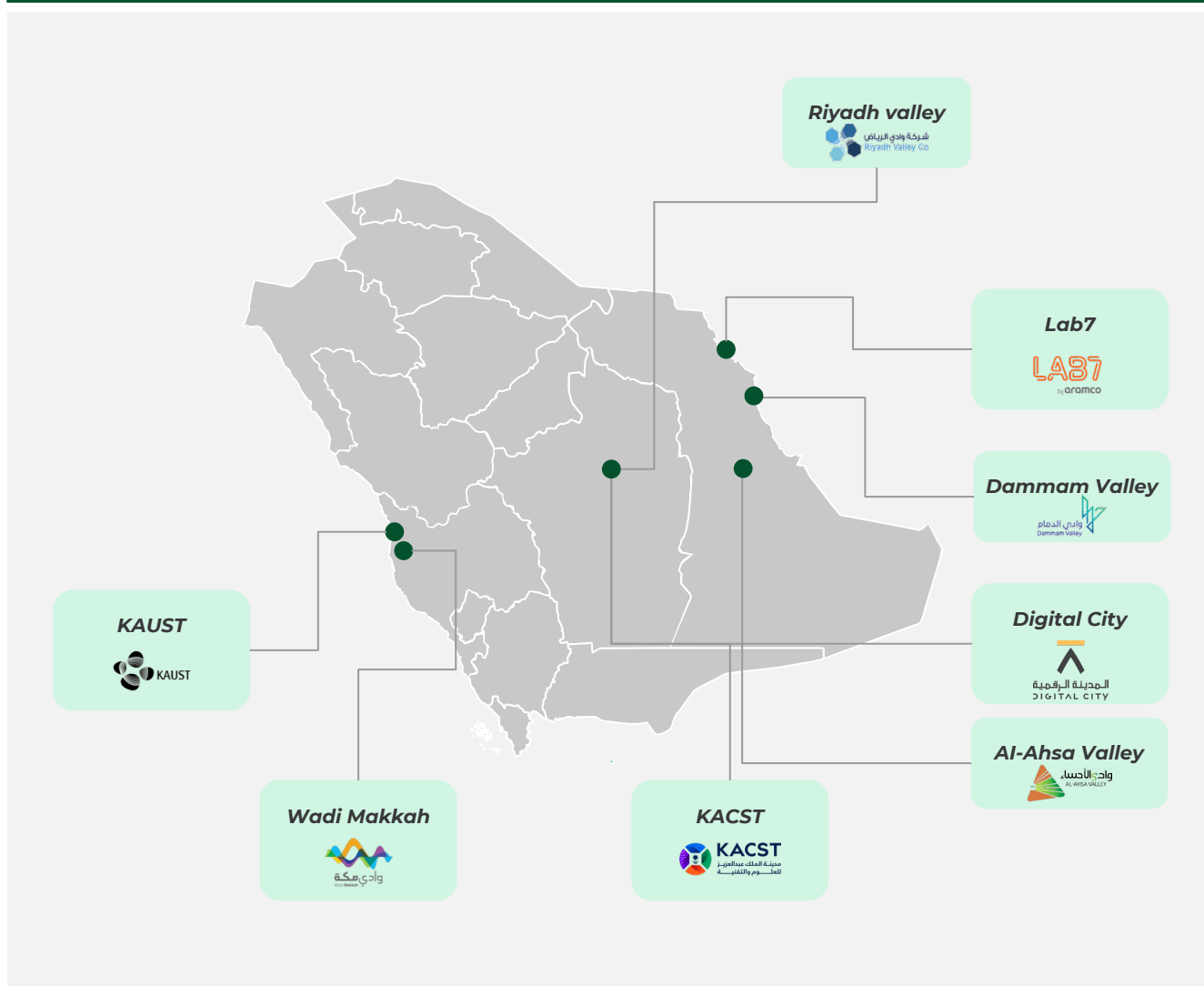
Furthermore, KSA is advancing its sustainable water management strategies by integrating modern infrastructure for efficient water supply chains. The desalination industry in the Kingdom is transitioning toward renewable-powered plants. The Saudi National Water Strategy outlines sustainable management of water resources by reducing groundwater depletion, increasing wastewater reuse, and enhancing water desalination technologies. KSA is working on enhancing the sustainability of its water supply chain by adopting advanced desalination technologies powered by renewable energy, like those developed at KAUST.

In the area of sustainable agriculture and food supply, the Kingdom is investing in research and development to optimize food production in arid conditions. The Kingdom's focus on food security includes collaborations with international agricultural technology firms and the development of sustainable agricultural practices. The Saudi Agricultural Development Fund (ADF) supports various initiatives to enhance food production systems, including hydroponics and vertical farming, as part of an effort to ensure self-sufficiency and sustainability in food supply. The fund also promotes the use of water-efficient farming technologies that are crucial for the Kingdom's arid climate.



The Kingdom of Saudi Arabia has invested significantly in computational facilities and data centers to support sustainability RDI. The King Abdulaziz City for Science and Technology (KACST) houses high-performance computing resources that facilitate large-scale data analysis and environmental modeling. These computational facilities are vital for processing complex datasets and advancing research in areas such as climate modeling and renewable energy optimization.

Figure 16: Multiple innovation clusters to be launched in KSA



To foster collaboration and innovation, KSA has established several co-working spaces dedicated to sustainability and essential needs RDI. These spaces provide researchers and startups with flexible work environments that encourage interdisciplinary collaboration. Notable examples include co-working spaces within the King Abdullah Economic City and King Saud University's innovation hubs, designed to stimulate innovation and cross-sector collaboration.

KSA has made concerted efforts to ensure broader access to RDI facilities for researchers and startups. Initiatives like the National Science, Technology, and Innovation Plan (NSTIP) aim to democratize access to advanced research infrastructure by providing funding and resources to a diverse range of stakeholders. Collaborative programs and partnerships with international research institutions further enable access to world-class facilities and expertise, supporting the Kingdom's ambitious sustainability and essential needs goals.

## ***Outlook for ecosystem infrastructure and supply chain***

This section outlines the strategic plans aimed at advancing the RDI in Sustainability and Essential needs' ecosystem infrastructure and supply chain in KSA.

### ***Expansion and enhancement of research facilities***

The Kingdom of Saudi Arabia plans to significantly expand and enhance its research facilities to support RDI in sustainability and essential needs. The policy direction will ensure these facilities are state-of-the-art and accessible to a wide range of stakeholders. The Kingdom will establish new advanced laboratories and research centers focused on critical areas such as renewable energy, water desalination, and environmental conservation. For example, a new state-of-the-art desalination research center is planned at KAUST, equipped with cutting-edge membrane technology and advanced simulation capabilities. Existing facilities at institutions like King Abdulaziz City for Science and Technology (KACST) and King Abdullah University of Science and Technology (KAUST) will be upgraded with the latest equipment and technology. Expansion of testing and prototyping facilities will enable researchers to validate their innovations in real-world scenarios. New simulation labs and pilot plants, such as the planned Renewable Energy Test Bed at the King Abdullah Economic City (KAEC), will be developed to ensure the safety of new products and processes.

### ***Development of innovation hubs and science parks***

To foster innovation and collaboration, KSA will develop new innovation hubs and science parks, providing essential infrastructure and a conducive environment for RDI activities. Innovation hubs will be established in strategic locations across the Kingdom, such as the King Abdullah Economic City (KAEC) and the Dhahran Techno Valley. These hubs will offer modern laboratories, office spaces, and collaboration areas, facilitating interdisciplinary research and innovation. The Dhahran Techno Valley will include facilities for energy research and development, supporting collaborations between academia and industry. Policies will provide incentives for the development of these hubs, including tax breaks and funding support. Existing science parks like Wadi Makkah and Riyadh Valley will be expanded to accommodate more research and development activities. These expansions will include additional facilities and resources to support startups and researchers. Policies will ensure these expansions are aligned with national RDI priorities and sustainability goals.

### ***Strengthening of incubators and accelerators***

KSA will strengthen its network of incubators and accelerators to support early-stage companies and startups in the sustainability sector. Programs like KAUST's Innovation Fund will be expanded to provide more resources, mentorship, and funding to startups. KAUST's Innovation Fund will double its investment capacity to support startups working on cutting-edge sustainability solutions, such as advanced solar panels and water purification technologies. New incubators and accelerators will be established, focusing on emerging areas within sustainability and essential needs. For example, the Green Tech Incubator in Jeddah will provide specialized support for startups developing green energy solutions. Moreover, MEWA is currently planning an initiative to facilitate the set-up of EWA-focused entrepreneurship spaces and support programs including incubators, accelerators, venture builders, co-working spaces, and technical assistance programs and clinics, in collaboration with the relevant national and sectoral stakeholders.

### ***Advancement of computational facilities and data centers***

Recognizing the importance of data and computational power in modern research, KSA will advance its computational facilities and data centers. Facilities like those at KACST will be upgraded to enhance their computational capabilities, supporting large-scale data analysis and environmental modeling. The KACST Supercomputing Center will see the addition of new high-performance computing clusters to facilitate complex simulations in climate modeling and renewable energy optimization.

***Promoting collaboration and accessibility***

To ensure broader access and collaboration within the RDI ecosystem, the Kingdom of Saudi Arabia will implement policies that promote inclusivity and accessibility. Policies will be developed to ensure open access to research facilities and resources for a diverse range of stakeholders, including startups, academic institutions, and private sector companies. These policies will promote collaboration and knowledge sharing across the RDI ecosystem. For instance, the National Science Technology and Innovation Plan (NSTIP) will mandate that research outcomes and data be shared openly to facilitate collaboration and innovation.

***Enhancing policy support and governance***

To ensure the effectiveness and sustainability of these initiatives, KSA will enhance its policy support and governance frameworks. Comprehensive policies will be developed to govern the RDI ecosystem, providing clear guidelines on funding, operations, and collaboration. These policies will ensure alignment with national sustainability goals and international standards. The Ministry of Environment, Water, and Agriculture will spearhead the development of these policies to integrate environmental considerations into all RDI activities. Robust mechanisms will be established for monitoring and evaluating the performance of RDI initiatives. This will include regular assessments, feedback loops, and adaptive policy measures to ensure continuous improvement.

By focusing on these strategic areas and supporting them with robust policies and policy directions, KSA aims to create a dynamic and resilient ecosystem infrastructure and supply chain for sustainability and essential needs RDI. These future-oriented initiatives will align with Vision 2030, ensuring sustainable development and positioning the Kingdom as a leader in global RDI efforts.



## 4.5 LINKAGES AND CULTURAL PROMOTION

### *Status quo and current efforts*

Significant strides have been made in fostering collaboration and partnerships in the sustainability and essential needs RDI ecosystem. To enhance collaboration between the public sector, private sector, and academia, the Kingdom of Saudi Arabia has implemented several formal mechanisms.

The RDI Authority (RDIA) plays a pivotal role in coordinating national RDI efforts, setting strategic priorities, and facilitating partnerships. RDIA's efforts include establishing joint research programs and funding consortia that bring together multiple stakeholders to work on high-impact sustainability projects. The National Science, Technology, and Innovation Plan (NSTIP) also supports collaborative RDI activities by providing a bridging platform for various sectors.

Several platforms and mechanisms have been established to promote collaboration in the sustainability and essential needs sector. The Saudi Water Council is a central body that fosters coordination among water providers, researchers, and policymakers. The National Center for Water Research also provides a framework for collaboration by integrating water research initiatives and supporting joint projects. KSA's Markets of Tomorrow Accelerator aims to support the development of initiatives that will nurture a global network of learning and mutual exchange. It connects experts and learning partners from the public and private sector and helps them identify new transformative markets and how best to access them. The accelerator has been launched with over 30 institutions to drive progress on the net-zero transition.

KSA hosts several key events and forums that facilitate interactions between researchers, industry professionals, and policymakers in the sustainability and essential needs sector. The Saudi Water Forum is a prominent event that brings together water leaders to discuss the latest trends and innovations. It provides a platform for networking, knowledge exchange, and collaboration. Saudi Water Authority and University of Tabuk have also partnered to host research community meetings.

Innovation districts and technology clusters are central to KSA's strategy for enhancing collaboration in sustainability RDI. The King Abdullah Economic City (KAEC) and the King Abdullah Financial District (KAED) are examples of innovation hubs that provide conducive environments for RDI activities. They house state-of-the-art research facilities, co-working spaces, and collaboration areas, promoting interdisciplinary research and innovation.

KSA has launched various initiatives and events aimed at fostering a culture of innovation and engagement in the sustainability and essential needs sector. For example, the Saudi Green Initiative brings together environmental leaders, researchers, and industry professionals to discuss the latest trends and innovations in sustainability. It provides a platform for networking, knowledge exchange, and collaboration, significantly contributing to the RDI community.

Another key initiative is the Misk Global Forum, which promotes youth engagement in RDI activities, encouraging young Saudis to pursue careers in sustainability research. The Ministry of Environment, Water, and Agriculture (MEWA) also hosts hackathons and innovation challenges, focusing on developing innovative solutions to sustainability challenges.

To motivate researchers and innovators, KSA has established several recognition programs and awards. The King Khalid Award for Sustainability is one of the most prestigious awards, recognizing outstanding contributions to sustainability research and innovation. This award not only honors individual achievements but also highlights the importance of research in advancing sustainability solutions.

Through formal mechanisms, platforms, dedicated events, and recognition, the Kingdom has created a collaborative ecosystem that drives innovation and ensures the sustainable development of solutions for essential needs.

## ***Outlook for linkages and cultural promotion***

This section outlines the strategic plans and policy directions aimed at advancing linkages and cultural promotion in the Kingdom of Saudi Arabia's RDI in sustainability and essential needs.

### ***Strengthening collaborative platforms and mechanisms***

KSA plans to strengthen and expand its collaborative platforms to support RDI in sustainability and essential needs. RDIA will expand its initiatives to establish more joint research programs and funding consortia. MEWA is planning on setting up an RDI partnerships framework, which governs the setup and management of RDI-themed partnerships in the EWA ecosystem fostering the participation of ecosystem entities and execute projects to setup various forms of outcome-driven partnerships such as industry alliances, academic collaborations, bilateral private sector partnerships, and intergovernmental alliances. The National Science Technology and Innovation Plan (NSTIP) will be expanded to provide a more comprehensive bridging platform for various sectors. This expansion will include the development of new collaborative frameworks and the integration of international partners to foster global cooperation in sustainability RDI.

### ***Hosting and expanding key events and forums***

KSA will enhance its efforts to host and expand key events and forums that facilitate interactions between researchers, industry professionals, and policymakers. The Saudi Green Initiative will be expanded to include more international participants and broader topics on sustainability. This initiative will host annual conferences, workshops, and seminars to promote knowledge exchange and collaboration. For example, the initiative will feature an 'International Climate Innovation Forum' to showcase global best practices and innovations in sustainability. New forums and conferences focused on emerging sustainability challenges will be introduced. These events will cover topics such as climate resilience, circular economy, and sustainable urban planning.

### ***Promoting youth engagement and cultural initiatives***

To cultivate a culture of innovation and engagement in sustainability RDI, KSA will implement initiatives aimed at promoting youth engagement and cultural development. The Misk Global Forum will be expanded to include more programs and initiatives that encourage young Saudis to pursue careers in sustainability research. This will include mentorship programs, innovation challenges, and entrepreneurship support. Policies will ensure sustained funding and institutional support for these initiatives.

### ***Recognition and awards for excellence in sustainability***

To motivate researchers and innovators, KSA will enhance its recognition programs and awards. The King Khalid Award for Sustainability will be expanded to include more categories and higher prize amounts. This will recognize outstanding contributions in various fields of sustainability research and innovation. Policies will ensure transparency and fairness in the selection process. New awards and recognition programs will be introduced to honor achievements in sustainability RDI. These programs will highlight the importance of research and innovation in advancing sustainability solutions. Policies will mandate regular assessments and updates to these programs to maintain their relevance and impact. For instance, the 'Green Innovator Medal' will be awarded to individuals that demonstrate exceptional innovation in sustainability.

By focusing on these strategic areas and supporting them with robust policies, KSA aims to create a dynamic ecosystem for linkages and cultural promotion in sustainability and essential needs RDI. These future-oriented initiatives will ensure sustainable development and position the Kingdom as a leader in global RDI efforts.

## 4.6 GOVERNANCE MODEL

***The Research, Development, and Innovation Authority (RDIA), in partnership with the Ministry of Environment, Water, and Agriculture (MEWA), plays a pivotal role in steering the Sustainability and Essential Needs sector in the Kingdom of Saudi Arabia.*** By adopting a mission-driven approach, RDIA and MEWA work collaboratively to ensure that research, development, and innovation (RDI) activities align with the Kingdom's overarching goals of sustainability, environmental conservation, and agricultural innovation. This governance model not only supports the Kingdom's sustainability goals but also fosters economic diversification and innovation, ensuring long-term environmental and economic resilience.

### ***How RDIA and MEWA govern the Sector:***

***Governance for missions:*** RDIA, in collaboration with MEWA, has established Mission Steering Committees that are multidisciplinary, including members from academia, the private sector, and government. These committees oversee and guide specific missions, such as achieving net-zero emissions by 2060 and reducing water withdrawal by 90% by 2035. They provide critical decision-making support, ensuring that missions align with national priorities and are executed effectively.

***Stakeholder engagement:*** RDIA and MEWA actively engage with universities, research centers, and the private sector to foster a collaborative environment. This engagement is crucial for the successful implementation of sustainability missions and for driving innovation in essential needs sectors.

***Policy development and implementation:*** RDIA and MEWA are responsible for crafting and enforcing policies that guide research, development, and innovation (RDI) within the sector. This includes setting regulations that promote the commercialization of sustainable technologies and practices, ensuring alignment with the Kingdom's sustainability goals.

***Sector-wide coordination:*** RDIA and MEWA work collaboratively to align all stakeholders, including public and private entities, with the national RDI strategy. This coordination is achieved through research councils and advisory committees that provide technical and scientific expertise to support the missions.

***Monitoring and evaluation:*** The governance structure includes regular monitoring and evaluation of ongoing projects and initiatives. RDIA and MEWA ensure that missions progress according to plan and deliver the intended economic and environmental benefits, ensuring accountability and transparency.

***Through this structured and mission-oriented governance model, RDIA and MEWA ensure that the Sustainability and Essential Needs sector is not only aligned with national priorities but also positioned to make a significant impact on the Kingdom's long-term environmental and economic sustainability.*** Their collaborative efforts, supported by robust policies, strategic coordination, and continuous stakeholder engagement, contribute to the Kingdom's vision of becoming a global leader in sustainable development and innovation.

***The governance model for RDI in Saudi Arabia, particularly for sustainability and essential needs, is structured to ensure that all efforts are closely coordinated and aligned with national priorities.*** The Research, Development, and Innovation Authority (RDIA) and the Ministry of Environment, Water, and Agriculture (MEWA) play pivotal roles in facilitating this collaboration. They work closely with key stakeholders, including universities, research centers, startups, and private sector entities. This collaboration ensures a cohesive effort toward sustainability and essential needs, with a well-planned allocation of capital, talent, and resources to the areas of highest priority.

A mission-based approach drives the governance framework, focusing on both immediate challenges and long-term strategic goals. This model helps direct efforts effectively and ensures that projects are outcome-oriented. By targeting specific, high-stakes areas, this coordinated system enhances the Kingdom's ability to meet its sustainability objectives and advance critical RDI initiatives. This alignment fosters innovation while addressing short-term needs and contributing to Saudi Arabia's broader Vision 2030 goals.



# SUCCESS STORIES

**Figure 17: KSA has made exemplary progress across multiple fronts in Sustainability and Essential Needs**



## **Renewable energy projects**

Saudi Arabia has made significant investments in renewable energy, including the development of the world's largest solar project utilizing cutting-edge Concentrated Solar Power (CSP) technology. This project, in partnership with NEOM, aims to produce 650 tons of green hydrogen daily, positioning the Kingdom as a global leader in renewable energy production

## **Carbon capture and storage**

The Kingdom's commitment to reducing its carbon footprint is exemplified by the establishment of a new carbon capture and utilization facility in partnership with Gulf Cryo. This facility captures 300 metric tons of CO<sub>2</sub> per day, achieving an 85% reduction in the annual CO<sub>2</sub> emissions footprint. The captured CO<sub>2</sub> is purified to food-grade level for reuse across various industries, demonstrating innovative approaches to carbon management

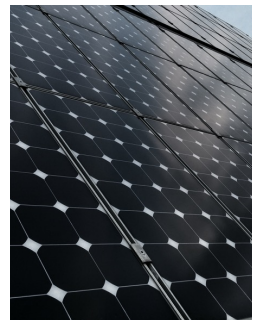


## **Desert agriculture solutions**

Saudi Arabia developed an innovative technology that transforms arid desert land into fertile soil, significantly enhancing agricultural productivity in challenging environments. Liquid NanoClay (LNC) technology binds sand particles together, creating a more fertile soil structure that retains water and nutrients more effectively. This method has the potential to revolutionize agriculture in desert regions, reducing water usage by up to 50% while increasing crop yields.

## **High-efficiency solar cells**

The development of high-efficiency solar cells and innovative lithium extraction from seawater are key achievements in the energy sector. These technologies enhance the efficiency and sustainability of solar energy production, reducing reliance on fossil fuels and promoting clean energy solutions



## **Innovative water solutions**

SWCC has developed some of the world's most energy-efficient desalination plants, significantly reducing the energy required to produce freshwater from seawater. These plants incorporate innovative technologies like reverse osmosis, energy recovery devices, solar-powered plants, and wastewater and brine management, contributing to the sustainability of water resources in the Kingdom.

**These success stories highlight Saudi Arabia's leadership in the sustainability and essential needs sector. By investing in innovative technologies and fostering strategic partnerships, the Kingdom is advancing towards its goal of becoming a global sustainability hub.**



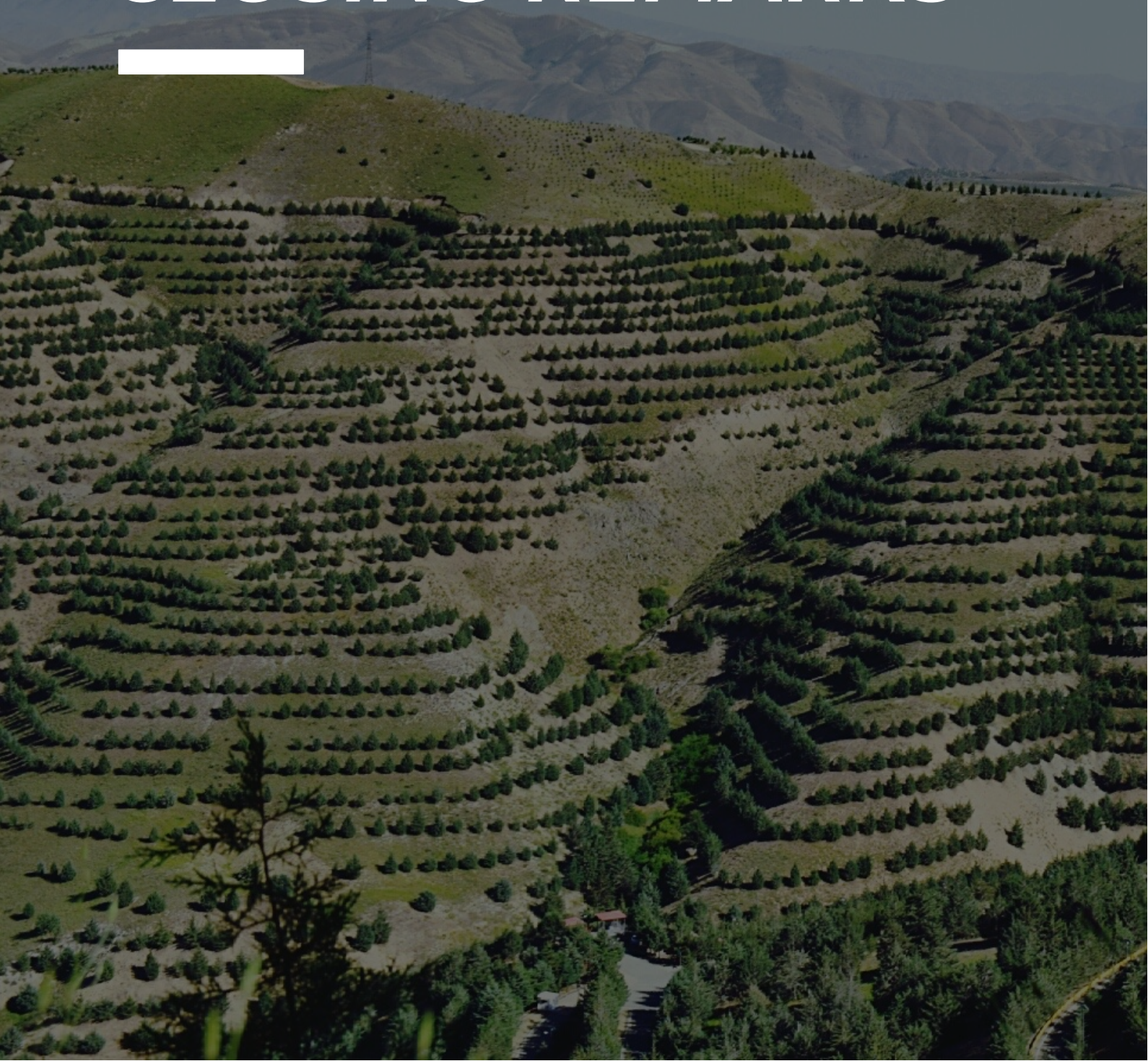




**05**

# ***CLOSING REMARKS***

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# 05

## CLOSING REMARKS

In conclusion, the strategic collaboration between the Research, Development, and Innovation Authority (RDIA) and the Ministry of Environment, Water, and Agriculture (MEWA) is pivotal for the success of Saudi Arabia's bold vision for a sustainable and innovation-driven future. The integration of RDIA's innovation framework with MEWA's extensive expertise in environmental stewardship ensures that our nation's efforts are both visionary and grounded in practical, real-world solutions.

As Saudi Arabia navigates the complexities of environmental challenges and resource management, this partnership exemplifies the kind of strategic collaboration necessary to propel the Kingdom to the forefront of global innovation. The missions and strategies outlined in this outlook are not just a roadmap for the future but a call to action for all stakeholders - government bodies, private enterprises, academic institutions, and international partners. Together, we can transform these ambitious goals into tangible outcomes, securing a sustainable and prosperous future for generations to come.

By fostering innovation and sustainability through this unified approach, Saudi Arabia is not only addressing its own critical needs but is also positioning itself as a global leader in the sustainability and innovation sectors. This joint innovation outlook marks the beginning of an exciting new chapter in the Kingdom's journey where the pursuit of excellence in RDI is intrinsically linked to the well-being of our planet and its people. We look forward to continuing this journey with renewed vigor, confident that through collaboration and innovation, we will achieve our shared goals and create a legacy of sustainability and innovation that will inspire the world.



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## GLOSSARY

### Abbreviations

### Full form

RDI	Research, Development, and Innovation
KSA	Kingdom of Saudi Arabia
GDP	Gross Domestic Product
MENA	Middle East and North Africa
MEWA	Ministry of Environment, Water, and Agriculture
SAR	Saudi Riyal
STEM	Science, Technology, Engineering, and Mathematics
GII	Global Innovation Index
RDIA	Research Development and Innovation Authority
SABIC	Saudi Basic Industries Corporation
WIPO	World Intellectual Property Organization
UNCTAD	United Nations Conference on Trade and Development
G20	Group of Twenty
R&D	Research and Development
Gen AI	Generative Intelligence
RDIA	Research, Development, and Innovation Authority
CAGR	Compound annual growth rate
EV	Electric Vehicles
AI	Artificial Intelligence
UK	United Kingdoms
GHG	Greenhouse gases
HTS	Harmonized Tariff Schedule
SGD	Singapore Dollar
HE	Horizon Europe
Tech.	Technical
EU	European Union
IoT	Internet of Things
Agri	Agriculture
GFAR	Global Forum on Agricultural Research
AgriTech	Agricultural Technology
ZLD	Zero Liquid Discharge
FLD	Forward Osmosis



## GLOSSARY

### Abbreviations

### Full form

RO	Reverse Osmosis
KCAST	King Abdulaziz City for Science and Technology
CCUS	Carbon Capture, Utilization and Storage
SMEs	Small Medium Enterprise
PIF	Public Investment Fund
VC	Venture Capital
CCS	Carbon Capture Storage
CO <sub>2</sub>	Carbon Dioxide
UN	United Nations
GCC	Gulf Cooperation Council
HVAC	Heating, Ventilation, and Air Conditioning
H <sub>2</sub> ICE	Hydrogen Internal Combustion Engines
IT	Information Technology
NTP	National Transformation Program
VRPs	Vision Realization Programs
SWA	Saudi Water Authority
MoE	The Ministry of Education
KFUPM	King Fahd University of Petroleum and Minerals
SBS	Saudi Basic Science
SART	Saudi Applied Research and Technology
YSG	Young Scholars Grant
BSG	Basic Science Grant
RCG	Research Consortium Grant
KAUST	King Saud University and King Abdullah University of Science and Technology
SVC	Saudi Venture Capital
KASP	King Abdullah Scholarship Program
SFDA	Saudi Food and Drug Authority
NSTIP	National Science, Technology, and Innovation Plan
KAEC	King Abdullah Economic City
CSP	Concentrated Solar Power
LNC	Liquid NanoClay
SWCC	Saline Water Conversion Corporation

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