Thematic Pillars of Research

- Energy and Environment
- Health and Biomedical
- Computing and Information Technology
- Social Sciences, Arts and Humanities

Qatar’s Cross-cutting Research Grand Challenges

1. Desalination/Waste water reuse:

Qatar has limited water resources and there is an obvious need to have sustainable, adequate quantities of freshwater that could be achieved through technology development and reform of unsustainable water consumption patterns. Qatar is also an industrial state and we are all aware of the adverse effects of industry on the water table (e.g., lagoon water contributes to underground reservoir levels, which has adverse effects on land quality in the form of erosion and other deleterious effects).

It is crucial for Qatar to address recycling and reuse of industrial water stores. Currently, water sourced with natural gas is chemically filtered and then re-injected into one underground aquifer. It remains unclear what the capacity of this aquifer is and no authority currently exists, to our understanding, to monitor and regulate this disposal practice.

R&D would aim to help by improving water management and desalination technologies, including improvements in the amount and quality of water available to Qatar. Some of the activities that will help to achieve this goal will be:

a. Conduct a technical assessment of near- and long-term technical options for providing water for Qatar’s residents and industries
b. Based on the aforementioned assessment, develop a multiyear research plan on water supply and desalination technologies
c. Create a basic and applied research program on water reuse
d. Develop a multiyear research plan directed at improving water quality, conserving water, and limiting discharges, including leakage
e. Conduct an analysis of the vulnerability of Qatar’s water supplies and identify measures that offer to improve water security
f. Develop and adopt safe and efficient methods of wastewater reclamation and reuse (e.g., irrigation, industrial use)
g. Study the wastewater situation in the State of Qatar (management, coverage, treatment and disposal) for both domestic and industry
h. Study the performance of wastewater treatment plants (WWTPs) in Qatar
2. Develop/deploy > 2% solar energy on grid/ Create high value products from natural gas:

Per capita energy use in Qatar is the highest in the world. This fact suggests that R&D institutions can play an important role in the design of a national energy security strategy including the identification and adoption of safe and economical alternate and renewable low carbon energy technologies and stores [e.g., solar, nuclear (fission and/or fusion), and wind energy]. To be successful, actions such as the following should be considered:

a. Evaluate and manage of pre- and post-peak natural gas and petroleum production and processing
b. Incentivize industry and the general public to adopt energy conservation, efficiency, and sustainability practices that preserve the environment and ecosystem (e.g., Smart Grid & Buildings technology)

c. Foster Oil/gas industry diversification through the development of by-product industries (e.g., polymers, plastics recycling, industrial polyolefin’s, natural fibers, packaging)
d. Assess, review and devise optimal ‘benchmark’ regulations and monitoring tools for energy security that are informed by international standards yet appropriate for the region

3. Sustainable food supply

Food imports account for > 90% of national food consumption with limited in-country reserves. As well, agricultural growth is limited by arable land, water, and energy capabilities that are being rapidly consumed by the growing population (e.g., food-water-energy-people nexus). This priority is also very closely linked to both Energy and Water (Water-Energy-Food sustainability). R&D will help inform and improve food security through the following activities:

a. Develop water and efficient agricultural management practices
b. Conduct research on soil and ground reclamation
c. Explore the feasibility of hydroponic, aeroponic and new greenhouse technologies
d. Develop a model to track the resource and policy relationships between water, energy, and food in Qatar
e. Develop a dynamic multi scale soil-plant-atmosphere water model of the desert environment in Qatar
f. Explore the feasibility of sustainable vertical farming using advanced techniques for water reclamation and space-efficient cultivation
g. Develop a coordinated multiyear plan for construction of a multiscale hydro geological model of Qatar

4. Environment & Society

Stakeholders felt strongly that Qatar should use and manage its resources responsibly and thus more research is needed in the development and implementation of "green" industry, "responsible" transportation systems, and about the impact on the urban landscape.

Mentioned were:

a. Identify and implement carbon capture and storage technologies that balance long-term carbon emission goals (e.g., air quality) with natural gas industry needs
b. Catalog and preserve biodiversity in marine, terrestrial, and urban habitats
c. Assess and mitigate environmental pollutants that pose risks for human health
d. Review and devise optimal 'benchmark' regulations and monitoring tools for the environmental impact of the energy industry, transportation systems (food, water, people), and urban environments; KPIs that are informed by international standards yet appropriate for the region

5. Sustainable Urbanization- Doha as a smart city:

Qatar is already a highly urbanized country and, with current infrastructure projects underway such as World Cup 2022 and the continuing rapid growth of the country, there are many opportunities for related and impactful R&D, including the following areas:

a. Implement a matrixed management structure (e.g., planning, communication, collaboration, implementation, quality assessment, accountability, and interconnectivity) of major inter-agency urban infrastructure developments
b. Review and development of optimal 'benchmark' regulations and monitoring tools to assess the performance and impact on the environment, resource use (e.g., water, energy), sustainability, safety, and culture of the region’s urban infrastructure
c. Assess and monitor population growth and patterns to ensure demand does not exceed available infrastructure (e.g., roads, healthcare services) and natural resources

d. Develop state-of-the-art technologies in infrastructure systems and materials unique to Qatar but adaptable to global industry

e. Create timely and transparent inter-agency communication and coordination to foster resource consolidation, meaningful data use, and minimize environmental impact

f. Evaluate and address policy and operational barriers to efficient local and international supply chain development, intelligence, consolidation, continuity, and sustainability (e.g., equipment, core materials, other commodities)

g. Adapt, reuse, and recycle abundant local resources (e.g., sand, clay) as market commodities

h. Develop and deploy an IT infrastructure that supports the rapid pace of planning and implementation

i. Design and build environments that foster healthy behaviors

j. Ensure that large urban projects deliver long-term benefits to the nation and its population

k. Establish cultural norms for development that meet the expectations of traditional Qataris as well as new inhabitants

6. **Mobility & Road Safety**

R&D could contribute to the design of a comprehensive and integrated transportation strategy and network (e.g., pedestrian, cyclist, road, bus, rail/Metro, sea, air). Actions taken would include:

a. Characterize and mitigate Qatar-specific trends and factors contributing to transportation-related delays, accidents, injuries, and fatalities

b. Enhance transportation safety awareness, adherence, and enforcement across public services and private industries

c. Characterize and mitigate barriers to mass transit use [e.g., environmental (climate or built), behavioral, cultural, gender-based]
d. Implement consumer-friendly ICT infrastructure (e.g., Smart transportation and logistics) to reduce congestion and enhance efficiency, safety, and economic opportunity

e. Engage and empower government, education, media, and medical sectors - along with the general public - in coordinated health and safety intervention efforts

f. Review and devise optimal ‘benchmark’ regulations and monitoring tools to assess the environmental impact, efficiency, and safety of the region’s transportation network; KPIs that are informed by international standards yet appropriate for the region

7. **Human Capacity Development**

This grand challenge (priority) will aim to develop sustainable talent for Qatar’s knowledge economy in order to meet the needs for a high-quality workforce. During the stakeholder interviews and workshops, specific R&D issues or targeted areas for research were identified that could contribute to help and overcome this challenge:

a. Better understand the scope and scale of the existing and projected workforce needs across all sectors in order to quantify the scope and scale of technical, vocational, and management training needs

b. Assess, project, and manage population demography shifts

c. Build diverse capacity of Qataris across workforce sectors (e.g., public, private) and disciplines (e.g., STEM, education, health services, social science, energy, environment)

d. Build intellectual capacity through recruitment and retention of early- and mid-career workers/investigators/faculty

e. Implement flexible labor policies that support knowledge transfer as workers move among sectors, industries, and organizations

f. Strategically draw on the complementary capacities and capabilities of the Arab region, and beyond

g. Foster an appreciation for the societal value of job skill development

h. Enhance the network of quality K-12 education providers

i. Create highly-valued and multidisciplinary tertiary and post-graduate education programs (e.g., BSc, Masters, PhD)

j. Develop technical training programs and perhaps a school to develop skills needed for national priority projects
8. Holistic and Systematic Assessment of the Rapidly Changing Environment

a. Assess the impact of rapid globalization, economic growth, and wealth on Qatar’s national identity, history, customs, religion, education, employment, and adaptive capabilities

b. Understand the role of behavior and culture at multiple societal levels (e.g., individual, family, institutional, national) in change management in the Qatari context

c. Foster motivation, scholarship, and prosperity among Qatari nationals and expatriates along with cultural accommodations that are in-sync with modern practice

d. Explore the roles of communication (e.g., education, journalism, traditional and social media channels) in fostering awareness of social issues and triggering behavioral change

e. Ensure that Qatar’s rapid development brings cultural value to all of its citizens

9. Managing the Transition to a Diversified, Knowledge-based Society

a. Build a knowledge-based society by emphasizing a robust research culture

b. Support innovation and entrepreneurship in both traditional and new industries, strategically aligned with Qatar’s strengths and capacities

c. Promote discovery, knowledge creation, innovation, and economic diversification through macroeconomic analysis of:
   i. Inflation management
   ii. Foreign direct investment and outgoing investment
   iii. Labor market mobility and flexibility

d. Diversify the workforce across public and private sectors

e. Develop Qatar- or Arab region-specific models, benchmarks, and best practices informed by international standards yet appropriate for the region

f. Create a framework of ethical principles unique to the Qatari context that inform behavioral and policy change

g. Foster awareness and understanding of local, regional, and national issues so that strategic plans are well suited to the unique challenges and resources of the region

10. Support of Culture, Arts, Heritage, Media and Language within the Arabic Context
a. Foster Arabic language education for the national and expatriate population through curriculum reform, professional development, and public programs

b. Support the documentation and digitization of Arabic language print and electronic media and vice-versa

c. Invest in the nation’s legacy in terms of:
   i. Arabic language resources
   ii. Arabic arts, design, and architecture
   iii. Arabic heritage and cultural programs
   iv. Ethnography

d. Understand and assess sports as a tool for cross-cultural integration and global cooperation

11. Developed modernized Integrated Health Management

R&D could contribute to a well-integrated and modern health care system by concentrating on the integration of primary-quaternary care with academic teaching and research programs, in order to foster translational medicine.

The community identified several efforts to support this goal:

a. Design national, evidence-based, epidemiological studies to assess and monitor diseases of high prevalence among the population (e.g., traumatic brain injury, cardiovascular disease and hypertension, diabetes, obesity and other chronic conditions, respiratory disease and asthma, maternal/fetal health, birth defects, genetic diseases, cancer, suicide, drug abuse, psychological disorders, and health risks associated with heat, air, water, and food quality)

b. Devise, implement, and assess models of enhanced access to primary patient care (e.g., Primary Health Centers, Private Practitioners, Community Pharmacy Networks)

c. Implement and assess models of enhanced access to secondary, tertiary, and quaternary patient care (e.g., Hospital-based and specialty care, Clinical Trials framework)

d. Improve standards of physician training and evidence-based patient care

e. Enhance technological infrastructure within the healthcare sector (e.g., eHealth, Bioinformatics, Telemedicine, Personalized medicine)

f. Cultivate healthy behaviors through public health, safety, and disease prevention campaigns (e.g., improved diet and exercise practices)

g. Initiate a community-based assessment in order to improve health outcomes
12. Assure cyber security

There is a critical need to assess and protect the cyber infrastructure in Qatar and create an organized legislative environment and multi-sector IT infrastructure to counteract cybercrime. This must include but not be limited to the:

   i. Financial System
   ii. Energy Grid
   iii. Utilities Systems
   iv. Transportation System
   v. Communication Networks
   vi. Individual consumers

   a. Investigate and prioritize networking, mobile technologies, big data computing, cloud computing

   b. Create training programs and awareness of data monitoring, evaluation, mining, privacy, and analysis management standards and best practices across all sectors (e.g., government agencies, commercial businesses, educational institutions, and private home users of all ages)

   c. Explore and implement best practices in Big Data Urban development projects