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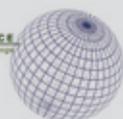
BUILDING R&D CAPACITY IN QATAR:

TACKLING THE WORLD'S WATER-ENERGY CHALLENGE – THINK GLOBAL, ACT LOCAL!

QATAR SHELL INNOVATION OPEN HOUSE,
NOV. 6-7 WORKSHOP – WHITE PAPER



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INTRODUCTION

Qatar Shell held its first Innovation Open House event in the Middle East in November, and as a highlight of the occasion we opened a new water laboratory at the Qatar Shell Research & Technology Centre (QSRTC) in Qatar Science and Technology Park (QSTP). The lab will carry out research and development into key water issues of relevance to the desert nation and other parts of the world.

HE Dr Mohamed bin Saleh Al-Sada, Qatar's Minister of Energy and Industry, inaugurated the water lab during the Innovation Open House in the presence of senior guests from academia and industry as well as senior Shell experts visiting from across the world. Among the more than 80 delegates participating in the Innovation Open House was Faisal Al Suwaidi, President of Research & Development at Qatar Foundation, along with a group of engineering students from Qatar University and Texas A&M University at Qatar who were recognized for their significant achievements in building fuel efficient cars for the Shell 2013 Eco Marathon, and they all had the opportunity to engage with an interactive exhibition of Shell's innovative breakthrough technologies.

As such, the two-day event marked the second edition of the 'Qatar Shell Dialogues' series that was launched in May as part of a broader initiative to set up a platform to exchange ideas and knowledge across business, government and academia to develop solutions on how to build the National Capacity needed to realize the goals of the Qatar National Research Strategy.

A majority¹ of industry executives and senior academics surveyed at the Qatar Shell Dialogues workshop in Doha in late May said Qatar had laid solid foundations for its pursuit of building a local energy R&D hub in the Gulf state, acknowledging that the government had taken a number of important steps so far that have put the country on the right track towards achieving its ambitious goal.





Tackling the World’s Water-Energy Challenge – Think Global, Act Local!

Initiatives to tackle the global water-energy challenge will require governments to put in place the relevant legal frameworks, while industry and academia need to take steps towards incentivising more young people into science and technology, and creating a culture in which innovation and research and development (R&D) can thrive.

In a survey conducted at the two-day Qatar Shell Innovation Open House (IOH) forum in Doha in November, two thirds of government officials, industry executives and senior academics expressed the view that the onus is on governments to build the partnerships necessary to solve the world’s water-energy nexus, with industry, academia and individuals all bearing some responsibility to make contributions .

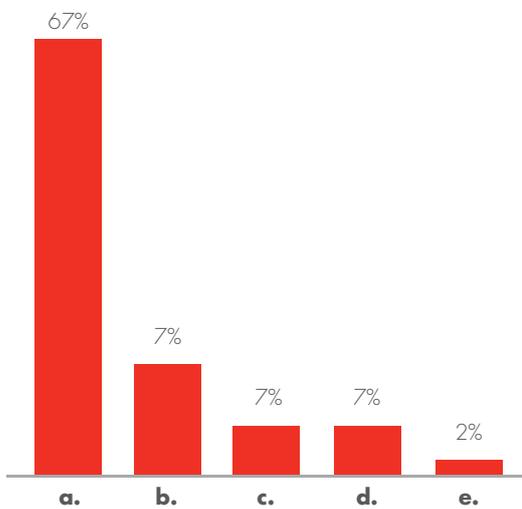
The survey also showed that 43% of respondents thought the most important initiative to leverage the interconnections between water and energy would be for governments to introduce laws that recognise the world’s resource limitations, while 26% considered engaging in sound science and producing high-quality data as key .

In a follow up to the Qatar Shell Dialogues workshop in May 2013, which produced 12 recommendations on how the energy industry can help Qatar build the national capacity needed to establish itself as a global R&D centre, the November forum also found that embracing a dynamic start-up culture that resonates with the younger generation should be the top priority for a company’s chief research officer (CRO)—if the position existed—to ensure that R&D recruitment objectives would be achieved. Interestingly, both students, who represent today’s young generation, and the group comprising government officials, industry executives and senior academics, in two separate surveys were majorly in favour of the above.

Taken together, the November and May survey findings and recommendations essentially add up to an agenda that aligns R&D mandates of both academia and industry with the government’s goal to placing Doha firmly on the map as a global hub for energy R&D, in line with the Qatar National Research Strategy (QNRS).

Graph 1:
Which pillar of society has the greatest responsibility to build the partnerships necessary to solve the water-energy nexus?

- a. Government
- b. Industry
- c. Academia
- d. Individuals
- e. NGO’s



¹ See Graph 1 – respondents comprised government officials, industry executives and academics surveyed on Nov. 7, 2013

² See Graph 2, page 4 – respondents comprised government officials, industry executives and academics surveyed on Nov. 7, 2013

³ See Graphs 3a & 3b, page 8

At the same time, the agenda connects Qatar's R&D ambitions with real-life challenges—water scarcity and the energy-water nexus—that are highly relevant to the Gulf state, its neighbours and a rising number of countries around the globe.

The finding and recommendations also puts significant emphasis on strengthening dialogue, understanding and partnership between government, industry, academia and indeed society as a whole.

THE ROLE OF WATER

"The opening of the Water laboratory here at QSRTC is an important step in addressing one of the greatest emerging research and development challenges in the Middle East, that of the efficient re-use of water"

His Excellency Dr. Mohammed bin Saleh Al-Sada

Minister of Energy and Industry, Chairman and Managing Director, Qatar Petroleum

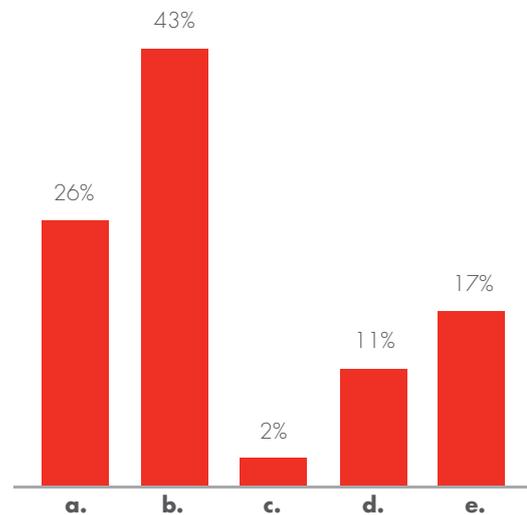
Experts anticipate that, by as early as 2030, the world may need 30% more water and 40% more energy. Although water and energy are so closely linked in today's world, they are very different kinds of natural resources.

Unlike hydrocarbons, water is essentially non-substitutable. Whether for drinking or irrigation – there is no replacement for it. As such, water is a critical resource for human life just as it is for almost all eco-systems, making it a multi-stakeholder, multi-generational imperative to overcome the swelling water-energy nexus.

Unfortunately, only 3 percent of the total water on the planet is fresh water, while about 97 percent is salt water from its oceans. Of the fresh water that's available, approximately 69 percent is frozen in glaciers and ice caps, leaving less than 1% readily usable for humans.

Graph 2:
What is the most important initiative you would recommend to leverage the interconnections between water and energy?

- a. Sound science, high-quality & reliable data
- b. Governments enact laws recognizing world's resource limitations
- c. Understand that past trends are less likely to predict future conditions
- d. Explain these complex interconnections to the public on a personal level
- e. Open Source technology, no hoarding



And even though water—unlike hydrocarbons—is finite but renewable, its renewal and sustainability won't be ensured if consumption exceeds its renewal rate. At a time of rapidly-rising water usage around the globe, water resources are therefore coming under significant stress, making already existing shortages more severe.

Added pressure is coming from a rising global population. Having crossed the 7-billion-inhabitants mark in 2011, the current world population of 7.2 billion is projected to increase by about 1 billion people within the next 12 years, reaching 8.1 billion in 2025 and 9.6 billion in 2050, according to the U.N. Department of Economic and Social Affairs⁴. This rapid and accelerated population growth puts strains on political and financial resources of companies and governments, and on the environment, including water resources.

According to the World Bank-sponsored 2030 Water Resources Group, demand for water worldwide may exceed supplies by 40 percent by 2030 at current growth rates. The Gulf States, including Qatar, which are located in one of the world's most arid regions with scanty rainfall, high evaporation rates⁵ and no rivers, are among the major contributors to this demand growth.

Driven by growing populations, the establishment of new industries and socio-economic development, the Middle East's water supply-demand gap has widened dramatically in recent years. As a result, Gulf States depend to a very high degree on desalination to meet their runaway water requirements. Today, the Gulf region accounts for nearly 50 percent of the world's desalinated water capacity.

In the Middle East-North Africa (Mena) region, desalination capacity is expected to grow from 21 million cubic meters a day (cm/d) in 2007 to nearly 110 million cm/d by 2030—of which 70% is in Saudi Arabia, the United Arab Emirates, Kuwait, Algeria and Libya, according to a joint report by the International Renewable Energy Agency (Irena) and the International Energy Agency's Energy Technology Systems Analysis Programme (ETSAP).

This will contribute to the surge in energy use in the region. The annual electricity demand for desalination in Mena is expected to rise to 122 terawatt hours (TWh) by 2030, a factor of three higher compared with 2007. In the U.A.E., for example, desalination requires about 10 times more energy than surface fresh water production, and its costs are projected to increase by 300 percent.

Indeed, the world's water and energy needs are so closely linked that, going forward, they can't be separated from each other. As a result, water and energy—together with food security and climate change—are the critical issues topping today's global policy agendas.

Energy companies—like other industries—are consumers of fresh water, if at a smaller scale than the agricultural sector for example. Still, according to the Paris-based International Energy Agency (IEA), each year the energy industry needs a volume of water that exceeds the 400 billion cubic meters per year carried by India's 2,500-kilometre long Ganges River.⁶

⁴http://esa.un.org/unpd/wpp/Documentation/pdf/WPP2012_Press_Release.pdf

⁵http://www.2030wrg.org/wp-content/uploads/2012/06/WRG_Brochure_2012-.pdf

⁶International Energy Agency, World Energy Outlook, 2012

As global energy demand continues to rise and more water-intensive methods are being applied to extract unconventional hydrocarbons such as oil sands, effectively managing the overall use of the resource through new and advanced recycling and reuse technologies is becoming seminal.

As such, the energy sector at large will have to intensify its efforts to address and prepare for future water challenges in many parts of the world. A stronger focus by the industry on R&D into water management, reuse, recycling and desalination is therefore essential. The launch of Shell's water laboratory in the Qatar Shell Research & Technology Centre (QSRTC) at the Qatar Science & Technology Park is one such initiative for Qatar to generate its own solutions for a local challenge that is also relevant globally.

"The energy sector is becoming increasingly concerned about water use as it becomes scarcer globally, new approaches and advanced technologies are necessary to help us reduce the amount of water we need in industrial operations, and to find innovative ways to re-use and recycle water from industrial processes."

His Excellency Dr. Mohammed bin Saleh Al-Sada
Minister of Energy and Industry,
Chairman and Managing Director, Qatar Petroleum



Qatar's particular challenges of having access to very limited fresh water reserves while at the same time growing rapidly both in terms of population and industrial development, mean the issue of water is more pressing here than in many other countries.

Setting up R&D facilities in the Gulf state therefore is an almost natural choice to tackle the water issue and develop local solutions that can ultimately be applied globally. It is also in line with the country's own vision to transforming itself into a knowledge economy and reducing its dependence on hydrocarbons.

There can be little doubt that R&D will play an important role in meeting the world's water challenge going forward. But it will only be one element in what needs to be an integrated economic approach to water resource management. Apart from energy companies, other private-sector stakeholders such as agricultural producers, technology providers and industrial water users will have to make critical water management decisions.

Governments will have to introduce policies aimed at increasing efficiencies, pricing water according to its real economic value, and reducing economies' water-intensity, in particular in countries that face scarce and diminishing water resources. In short, it is vital that all stakeholders get together if a water crisis is to be averted.

To this end, energy companies in Qatar have begun reaching out to external stakeholders, both private and public, to forge the types of partnerships necessary to leverage the water-energy nexus – with a keen awareness of the fact that every drop of potable water produced uses energy and every kilowatt hour of energy produced uses water. Conversely, every drop of water saved conserves energy and every unit of energy saved conserves water.

Importantly, today's water-energy nexus cannot be looked at without a third element that's directly connected to both: food. Large amounts of energy are needed to fertilise and transport crops, and to pump water to drier regions. At the same time, water use and agriculture are inextricably linked, with farming accounting for around 70% of water used in the world today.

Given the complexity of the nexus, the overall goal will have to be building partnerships that ensure long-term sustainable development through initiatives aimed at inter-industry collaboration and developing multi-stakeholder strategies that deliver greater energy efficiencies and water saving benefits.

"At the World Food Program we've identified private-sector partnerships as one of the most essential engagements to deliver the solutions we need because no longer can governments do it alone," **Ashraf Hamouda, Head of Partnerships & Business Development, Middle East, Eastern Europe & Central Asia, United Nations WFP**, said at the Qatar Shell IOH forum. "It is important to get industry involved to leverage the brightest minds working on the hardest problems."

A comprehensive solution to the nexus won't be possible without engaging with the agriculture sector, for example, in an effort to make the best use of existing resources. Energy companies including Shell have begun identifying opportunities to use the outlet from agriculture in its own operations, thus indirectly collaborating with the sector in food production. This type of collaboration potentially works in both directions.

Energy projects such as Pearl GTL, whose water treatment plant is comparable to that for a city of 140,000 people, have the potential to provide water for certain agricultural uses such as landscaping and potentially for food production as well.

THE ROLE OF R&D AND QATAR

Qatar, which is in the early stages of building its R&D capabilities and setting its priorities, has taken important steps towards playing a leading role in tackling the local and global energy-water challenge. It may still be early days but QSTP, which today is home to numerous large energy and technology companies, is beginning to emerge as a platform that supports dialogue, understanding and partnership between industry, the R&D community and local academia.

Going forward, QSTP could become an R&D and innovation incubator in all three areas that make up the water-food-energy nexus, focusing on local issues that are also of relevance globally.



"We all share a joint commitment to supporting research in Energy and Environment, a key theme in Qatar's National Research Strategy which Qatar Foundation is pioneering. We recognize that close collaboration between the R&D community, academia, and industry partners is essential to remain steadfast in our support to the Qatar National Research Strategy (QNRS) and the Qatar National Vision 2030 ambition to foster a knowledge based economy. "

Faisal Al-Suwaidi, President of Research and Development at Qatar Foundation for Education, Science and Community Development

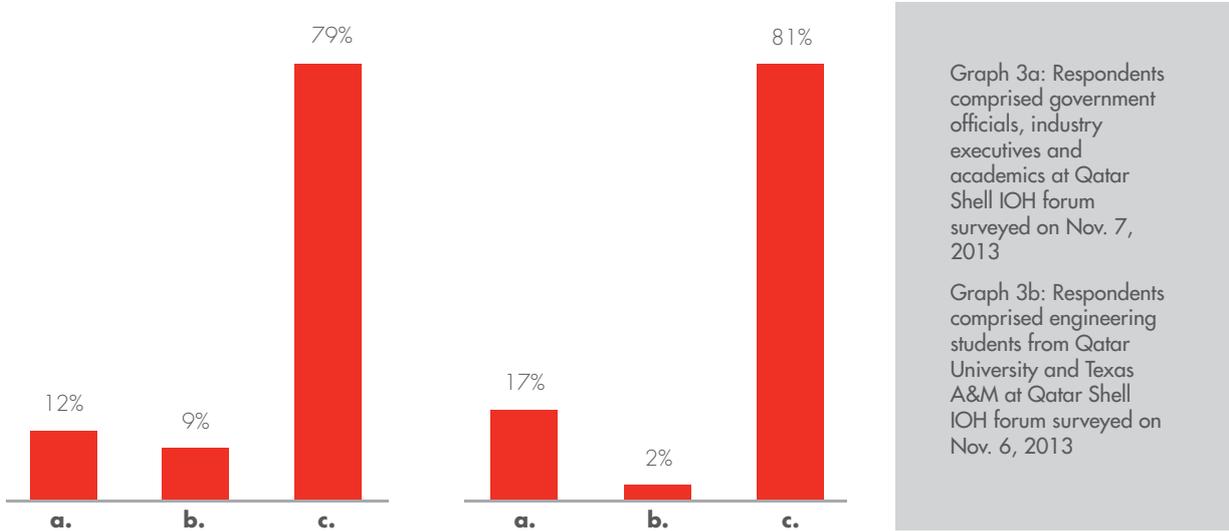
Given that Qatar's wealth is grounded in its hydrocarbons reserves, a focus on R&D in the energy sector on the one hand and on water, which poses one of the greatest challenges to sustainable development in the country, represent logical extensions of the country's existing realities. Moreover, given its lack of water resources, Qatar naturally has to rely on food imports for almost all the domestic requirements, thus making food security a key priority for the country.

The IOH forum’s survey findings that efforts should be made to produce more food on the same amount of land with less water reflects a broader view that ongoing R&D into water issues will be integral to finding new solutions and technologies to tackling the issue .

Graphs 3a & 3b:

In a recent survey, 44% of respondents identified that “connecting the boardroom to the Lab through a new leadership post of Chief Research Officer” would be the best initiative for industry to adopt to help attract national talent into R&D. What should be the top priority of the CRO post to ensure recruitment objectives are achieved?

- a. Align R&D compensation levels and incentive structures with business
- b. Get board members directly engaged with recruitment
- c. Embrace a dynamic start-up culture that resonates with the younger generation



Graph 3a: Respondents comprised government officials, industry executives and academics at Qatar Shell IOH forum surveyed on Nov. 7, 2013

Graph 3b: Respondents comprised engineering students from Qatar University and Texas A&M at Qatar Shell IOH forum surveyed on Nov. 6, 2013

For Qatar, the benefits of implementing its national research strategy go beyond technological breakthroughs. Establishing the country as a centre for R&D is integral to the government’s broader vision to foster human, social and economic development as it seeks to evolve into a sustainable, knowledge economy.

Advancing education is—as repeatedly stated publicly by Qatari authorities—a prime objective in this context. To do so, QNRS has made capacity building a key priority. This will enable all stakeholders to work together to ensure that the country’s youth engages with and chooses careers in science and R&D.

With this in mind, the agenda that emerged on the back of the November and May survey findings and recommendations concisely links all key elements that are relevant to Qatar’s R&D ambitions and solving the water-energy nexus.

Building on existing structures in Qatar and bringing together industry players and external stakeholders on key issues will now be the name of the game. The International Petroleum Technology Conference (IPTC), whose goal is to advance scientific and technological knowledge, will be the next milestone. The addition of a comprehensive Young Members Activities, including Education Week, at IPTC fits perfectly well into the agenda.

Graph 4:

Less than 1% of the world's water is fresh groundwater and the vast majority of this water is used in agriculture. How can this keep delivering?

- a. Tax water consumption
- b. Produce more food on the same amount of land with less water
- c. Prioritise i.e. Ban potatoes! a wheat grain contains up to 25% water, a potato 80%
- d. Multilateral financing for micro solutions at community level
- e. All of the above and more

