

THE ROLE OF MASDAR INITIATIVE AND MASDAR INSTITUTE OF SCIENCE AND TECHNOLOGY IN DEVELOPING AND DEPLOYING RENEWABLE TECHNOLOGIES IN EMERGING ECONOMIES

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Abstract

Masdar Institute of Science and Technology has been established to play an integral role in the Emirate of Abu Dhabi, United Arab Emirates, in researching, developing, implementing and exporting new technology related to alternative energy and sustainability. The institution is the key element of a wider initiative by the Government of Abu Dhabi to find sustainable alternatives to fossil fuels by developing technology that will be scalable and provide commercially viable solutions globally.

This paper examines the opportunities and precedents for Masdar Institute of Science and Technology to play an integrated role with business, government, policy makers and society to advance the cause of sustainability, and develop models that could be easily adopted by developing countries in Africa and other parts of the world.

Introduction

The United Arab Emirates is one of the world's wealthiest countries and in recent years has enjoyed an impressive growth rate. Nominal Gross Domestic Product (based on current prices) grew 16.8 per cent in 2007 to AED729.73 billion (USD 202.7 billion). In 2006 it recorded a 28.7 per cent growth in GDP, and in 2005 it came to 25.6 per cent. [1] The historical source of the country's enormous wealth has been its hydrocarbon assets; however a careful strategy of diversification has helped balance the contribution from oil and gas with other sectors. In 2007, the non-oil part of the economy contributed 64.1 per cent of overall GDP. [2]

Nonetheless, hydrocarbons remain the single most significant sector in the country's economy. It has the fifth largest proven oil reserves [3] and the fourth largest gas reserves in the Middle East [4]. After oil was discovered four decades ago, the country has used its riches to invest heavily in creating infrastructure, and developing modern cities where none existed before. The first tar road was reportedly only constructed in the nation's capi-

tal, Abu Dhabi, in the 1960s, and photographs from as late as the 1960s and 1980s reveal that it was little more than a small town. Today, the UAE has a population of 5-million [5] with Emiratis (UAE nationals) comprising 18% and the remainder comprising expatriate workers from more than 200 nations. The

population is clustered around the three main cities – Abu Dhabi, the capital, Al Ain (the second largest city in Abu Dhabi Emirate) and Dubai.

In 2008, Abu Dhabi launched its strategic five-year plan for 2008 to 2012. The objective of this diversification and liberalization program is not to move away from a hydrocarbon-based economy. Rather, it is aimed at building a more business-friendly environment that leverages the strength of its oil and gas sector to strengthen existing industries, move into new sectors, and to transform its economy from a conventional, labor-intensive economy to one based on knowledge, technology and highly-skilled labor.

As part of its diversification, the Emirate has started investing heavily in alternative energy to protect its position as a leading energy player in the world, and to help develop the UAE into a knowledge-led economy to ensure that it rapidly reaches a position where intellectual capital can be exported rather than imported, as is the case at present. It is important to remember that while the majority of foreign workers in the UAE are unskilled, the country has relied heavily in the past few decades on attracting a skilled foreign workforce, which has played a significant role in helping the UAE play catch-up with the rest of the world.

The social and political history of the UAE provides important context to understanding the investments in the area of renewable energy and sustainability. The country only came into being as an independent nation in 1971 after existing as independently run 'trucial' states under the colonial mantle of the United Kingdom. In addition, the largely nomadic native inhabitants had little or no access to institutionalized education or technology until the sec-

ond half of the 20th century. As late as 1975, the rate of adult literacy was 54% among men and 31% among women. Today, literacy rates for both genders are nearly 90%. [6]

At first glance, the casual observer may think that the UAE has little in common with Africa, however a closer look reveals many similarities: vast natural resources; significant development requirements; a colonial legacy; tribal cultures; and historically insufficient education. Clearly Africa has a number of critical concerns – conflict remains rife, poverty is widespread, unemployment is high, and socio-economic stability is fragile. Nonetheless, African countries have the same needs as the UAE – energy security, the creation of diversified economies, and the requirement to promote education. Currently, the UAE is making great strides towards these targets. This is not an achievement it plans to guard jealously because it understands that it does not exist in isolation from the rest of the planet. Indeed, the Abu Dhabi Fund for Development has created a special endowment of up to US \$50 million until 2016 to be used for loans in support of renewable energy projects in the developing world.

In the UAE, recognition that education is pivotal to its over-arching goals has been mirrored by the acknowledgement that standards need improving. This has triggered initiatives at all educational levels, as well as invitations by the UAE to foreign universities to establish campuses in the country. For example, in 2006 an international partnership agreement was signed in 2006 between the Abu Dhabi Authorities and the Sorbonne, which was established over seven hundred years ago. Investment in improving the quality of education at primary and secondary schools is designed to raise the standards of education to a level where UAE students are able to graduate from high school with the requisite skills to meet the entrance criteria of universities around the world. Currently, many students need to complete two-year foundation courses after they complete secondary school in order to meet the entrance criteria of foreign universities. [7] The Abu Dhabi Education Council has identified four main subject areas as needing specific attention: Mathematics, Science, Arabic and English.

It is a given that improving education standards is a long-term investment, and that there is no ‘quick fix’. The enhancements to the primary, secondary and terti-

ary education system may well take a generation to bear fruit, and the contribution from foreign universities, such as the Sorbonne and New York University, will similarly not produce results overnight. Still, each one represents an important element of a strategy to become a knowledge exporter. When combined with the Government’s determination to find ways to secure its global role as one of the planet’s most important energy producers, both arguments provide two of the cornerstones of the creation of the wider Masdar Initiative. Education, energy and the environment are all inextricably connected to the country’s future.

The current administration in Abu Dhabi, which is the nation’s capital, frequently invokes the legacy of the late Sheikh Zayed bin Sultan Al Nahyan, founding president of the UAE. Sheikh Zayed is widely credited with promoting investment in educating the youth, and raising awareness of the need to preserve the environment. The influence of the late ‘founding father’ of the UAE is significant, and it has played an incontrovertible role in the current strategy to find sustainable and renewable sources of energy.

The formation of Masdar and its various affiliated and subsidiary companies represents the Government’s most important commitment to its goals of developing sustainable, alternative energy and creating a knowledge economy. Masdar was established by Mubadala Development Company (Mubadala), which is a Public Joint Stock Company headquartered in Abu Dhabi, capital of the United Arab Emirates. Mubadala’s sole shareholder is the Government of the Emirate of Abu Dhabi. Related to Masdar but operated and funded completely independently is the Masdar Institute of Science and Technology, which was established in 2007 to become the Middle East’s first graduate institution dedicated to the research and development of sustainability and renewable energy. The first intake of 88 students was enrolled in five Masters programs in September. The Institute was established with the support and collaboration of the Massachusetts Institute of Technology. Most of the 21 faculty at Masdar Institute spent time at MIT ahead of the first academic year to formulate the curriculum.

The Institute is not only working at the graduate level, however. As previously mentioned, school curricula are being overhauled, and the Institute has signed a Memo-

randum of Understanding with the Abu Dhabi Education Council, and the Ministry of Education to assist in raising the level of instruction in these subjects.

Research conducted by Dr Georgeta Vidican at the Masdar Institute has shown the value of universities in innovation and sustainable development in five areas. Apart from contributing to primary research and combining existing knowledge, universities also play an important role in education and training (curriculum development); creating space for open exploration of ideas; and in involving communities. It is not only technology development that is important, but also the other contributions to bringing about positive social change. [8]

The rapid emergence of climate change as a global issue affecting everyone on the planet, combined with the lack of technology, policy and infrastructure to tackle the problem adequately has created the impetus for greater involvement by academia. Universities are able to transcend all the other traditional pillars of society – government, business, and civil society – to help develop solutions in more productive and efficient way than each of the pillars could do individually. Universities are critical in pushing technological frontiers and setting the agenda for future research by providing a space where researchers, the private sector, and government can come together to explore technology and industry pathways.

This is precisely what Masdar Institute is doing: it has a mandate to develop sustainable and renewable alternatives to fossil fuels in an environment where it will be able to ‘test’ emerging technology in Masdar City, which is the arm of Masdar Initiative that will house sustainability enterprises in a zero-waste, carbon-neutral city. The entire value chain of Masdar Institute will encompass theory, research, testing, application and commercialization in an environment that will be a role model for cities of the future. In addition, the decision to locate the headquarters of the new International Renewable Energy Agency in Masdar City will allow the Institute to become involved in policy formation for the entire planet.

As Vidican also notes, universities are able to contribute to industrial transformation by increasing the capacity for scientific and technological problem solving. [9] The legacy of the UAE regarding education – a situation shared by many developing nations - has produced relatively low ability in both these areas. Leveraging a strong resources base to develop academic centers of excellence can transform a society from one reliant on outsiders for

technology to a nation that becomes an exporter of innovation.

A recent study has underscored the value that universities play in both innovation and stimulating economies, using MIT as the core example. The Kauffman Foundation produced a study that was published in early 2009, analyzing the economic effect of MIT on Massachusetts. [10]

According to the study, if the active companies founded by MIT graduates formed an independent nation, the combined revenue would make it the 17th-largest economy in the world. “Within the US, these companies currently generate hundreds of billions of dollars and hundreds of thousands of jobs to regional economies, particularly those in Massachusetts and California. Globally, a less conservative estimate of their annual world sales would equal \$2 trillion, producing the equivalent of the 11th-largest economy in the world.” [11]

The report was based on a 2003 survey of all living MIT alumni, with additional detailed analyses, including recent verification and updating to 2006 of revenue and employment figures. According to the survey, about 6,900 MIT alumni companies with worldwide sales of approximately \$164 billion are located in Massachusetts alone and represent 26% of the sales of all Massachusetts companies. [12] In addition, 4,100 MIT alumni-founded firms are based in California, and generate an estimated \$134 billion in worldwide sales. [13] States currently benefiting most from jobs created by MIT alumni companies are Massachusetts (estimated at just under one million jobs worldwide), California (estimated at 526,000 jobs), New York (estimated at 231,000 jobs), Texas (estimated at 184,000) and Virginia (estimated at 136,000). [14]

Another reason MIT is so important to the Massachusetts economy, is that without the university, most of these companies never would have been located in Massachusetts. [15] Most of the MIT alumni companies in Massachusetts were founded by former students who came to the state to attend MIT, liked what they saw, and eventually started their companies there. Less than 10 percent of all MIT undergraduates grew up in the state, but approximately 31% of all MIT alumni companies are located in Massachusetts. [16]

Not only do MIT alumni, drawn from all over the world, remain heavily in Massachusetts, but their entrepreneurial offshoots benefit the state and country significantly. [17] More than 38% of the software, biotech and electronics companies founded by MIT graduates are located in Massachu-

setts, while less than 10% of arriving MIT freshman are from the state. [18] More than half of the companies started by MIT's foreign-student alumni are located in the US, creating their primary employment and economic impacts here. [19]

Another good parallel is provided by the role that Stanford University played in the creation and evolution of Silicon Valley. Similar to Stanford, Masdar Institute will be the center of gravity for renewable energy and sustainability activity in Abu Dhabi, and in particular to Masdar City. It will provide a mobile, high quality workforce; a culture that rewards risk-taking; a spirit of community collaboration even in a competitive environment; the availability of financial resources; university interaction; quality of life; government involvement especially in terms of supporting research; and specialized business support infrastructure. [20] In addition, other research has shown that additional factors also play an important role: university encouragement of an entrepreneurial spirit and collaboration with industry, among other factors. [21]

As a result of the involvement of Stanford, university staff, faculty and graduates have launched over 1,200 companies in the past five decades, and more than 50 percent of Silicon Valley's products come from companies created by Stanford alumni. [22] Just as Stanford and Silicon Valley provided a role model for Masdar and Masdar Institute, so can the Abu Dhabi effort create a model for other developing nations to copy for their benefit.

As previously indicated, the role of Masdar Institute will not be restricted to graduate education. Alongside a global focus that will manifest in a collaborative relationship with the International Renewable Energy Agency (IRENA) and other leading universities from around the world, is a local approach to transform the UAE's behavior via community outreach. Much has been said about the UAE having the highest ecological footprint in the world [23], and other environmental issues – such as water conservation and waste disposal – require concerted action. Already the Institute has started some small programs to educate the local and expatriate populations about the importance of sustainability and the need to develop renewable energy sources. In the next calendar year, a number of more ambitious programs will get underway to begin educating children and adolescents in the UAE (and later across the Middle East) about

sustainability concepts. In addition, the Institute has signed a Memorandum of Understanding to help the Abu Dhabi Education Council raise the standard of curriculum and instruction in the subjects of Mathematics and Science – both being key subjects in a wide-ranging improvement program initiated by the education authorities.

Vidican notes that through their interactions with local governments, universities can develop programs that involve local communities more effectively than the government or private sector can, while also maintaining their core competence in education and research. [24]

The relationship between universities and business is equally important. The Masdar Initiative aims to create a new 'Silicon Valley' around sustainability and renewable energy at Masdar City. The aim is to attract companies that are investing their own funds into developing products and services that will have the same multiplier effect on sustainability as Silicon Valley had on the IT industry. However, the private sector cannot – and will not – provide all the solutions, due to vested interests and competition. The role of universities in cutting across the interests and capabilities of government, business and civil society is further supported by Vidican's research, which reveals that whereas universities are committed to the exchange of ideas and knowledge, the private sector is far more proprietary. [25] Unlike academia, entrepreneurial enterprises are beholden to stakeholders that want a tangible return on their investments – and this generates secrecy and competition. Some areas of sustainability may well prove too expensive for the private sector to research and develop, with no guarantee of a return. In this scenario, the value of academia is immeasurable, by ensuring that all the challenges are addressed – and not only those where the profit motive is clear. In Masdar Institute's case, its role is even more essential: it has a mandate not only to develop alternative energy and sustainable technologies, but to do it in a way that is significantly scalable, and – equally importantly – cost effective. The private sector's motives are different and clearly not necessarily motivated by providing the best product at the cheapest price for a mass consumer audience.

Dr. Toufic Mehzer, another of the leading academics at Masdar Institute, has produced in-depth research on the role of the "Technology Triangle" in helping Middle East economies to develop in instances where there has been damage to social, environmental, and human resources. Mehzer describes the Technology Triangle as strategic in-

teraction and cooperation between the scientific and research community, business and industry, and institutions of governance. [26] The Technology Triangle is focused on human capital development, business development, building up the infrastructure, wealth generating capacity, competitiveness, and the sustainable development of the country. [27]

Notwithstanding the importance of academia in transcending the natural limitations of the other pillars of society, it is important to remember – as Mehzer established – that science and technology institutions depend on government and the private sector. [28] The government presses institutions for better performance in return for financial support. Pressure is also exerted by the private sector in terms of the quality of their products and services – the human capital as well as the intellectual property. If all three parties of the Technology Triangle meet each other's needs, the Technology Triangle becomes an effective mechanism for sustaining the technology capabilities of a society. [29]

Conclusion

The effective functioning of a society that is pursuing both economic growth and environmental sustainability rests on the efficient functioning of the education system. This is true in other areas as well, such as banking and finance – poor education impedes the ability of populations to use sophisticated financial services.

Masdar Institute is cognizant of the integral role it is playing towards achieving the goals that have been set by the Government of Abu Dhabi. Given that it is essentially the first graduate academic institution in the world that is devoted to the study and development of renewable energy and the promotion of sustainability, it will be sailing through uncharted waters. Clearly precedents exist, as Vidican and Mehzer show, providing some guidelines for the Institute. Furthermore, there is nothing that Masdar Institute is attempting that can't be replicated in other parts of the world facing similar challenges.

With the emphasis so firmly on developing alternative energies that are scalable and cost efficient, Masdar Institute's output from the afore-mentioned collaborations with government, the private sector, IRENA and others will be of value to other developing economies. Perhaps more importantly, its success will offer a very positive role

model, allowing developing economies to benefit from the achievements of one of their own.

To paraphrase from a well-known parable about teaching a man to fish, if the UAE and other fossil fuel producers provide developing nations with non-renewable energy, they will only be able to help them until the fuel – or the money – runs out. Given current projections, this deadline is rapidly approaching. But by sharing new technology and sustainability innovations, and making them affordable and scalable, the UAE will aid developing nations in coming up with their own solutions. As the countdown clock ticks ever louder for our planet, it is in all our best interests to offer a helping hand.

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