Industry

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I. INTRODUCTION

Increasing awareness about mankind's contributions to climate change is creating new pressure for carbon-intensive sectors to reduce their greenhouse gas (GHG) emissions. The potential for irreversible consequences has prompted national governments around the world to devise ambitious plans to address global warming and its possible damage to ecosystems and the global environment.

Although Arab countries have increased their emissions substantially over the past two decades, as illustrated in Figure 1, they are still relatively moderate emitters of GHG emissions, making up a minor fraction of global emissions. Furthermore, Arab countries are currently not legally bound by an accord that obliges them to reduce their emissions.

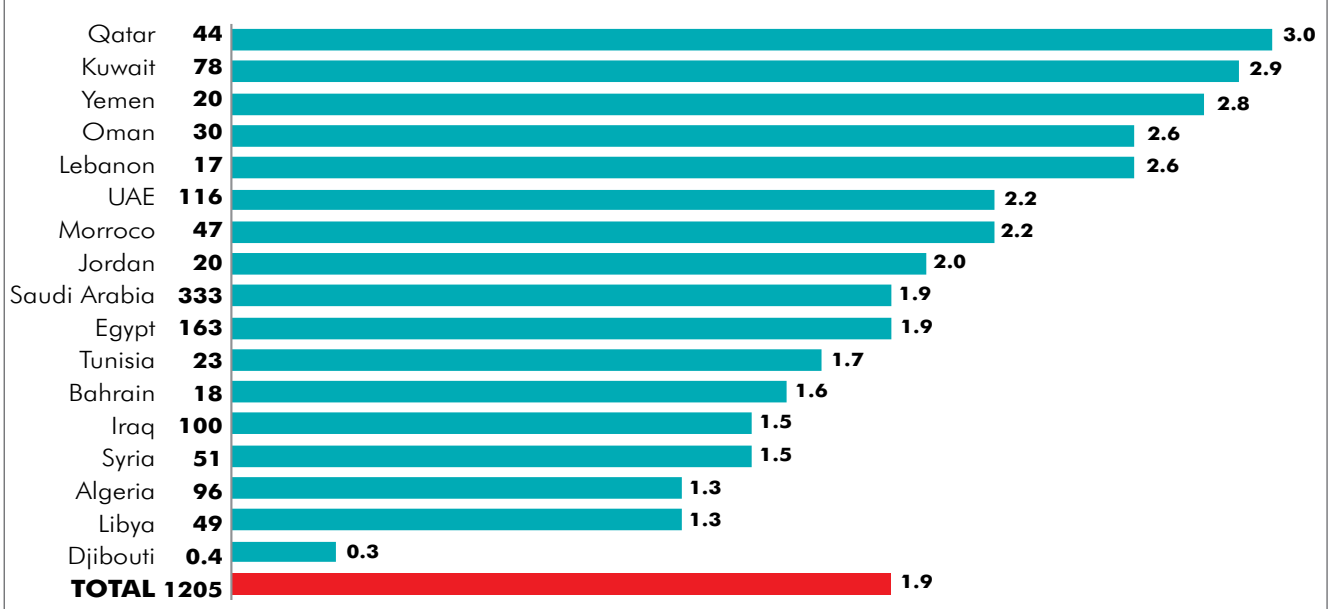
However, Arab countries should develop low carbon industrial development strategies motivated by the opportunity to:

1. **Prepare local industries for a low-carbon world.** The shift to low-carbon products could significantly impact the competitiveness of Arab industries. The European Union and the USA for example, have proposed measures to penalize free-riding behavior of countries with no GHG emissions targets, which could potentially impact trade and exports of developing countries that do not act to reduce their emissions.

2. **Take advantage of opportunities to generate jobs and diversify gross domestic product (GDP).** The upcoming energy shift will create opportunities to enter new industries such as the manufacturing of solar and wind equipment and exporting renewable energy to Europe. Arab countries can take advantage of these new opportunities to generate employment and diversify their GDP, helping them in their transition to become knowledge-based economies.

3. **Save fuel and reduce cost. Saving fuel**

FIGURE 1 ARAB COUNTRIES CO_2 EMISSIONS* GROWTH FROM 1990 TO 2005



* $MtCO_2e$: Metric ton carbon dioxide equivalent
Source: Pennell et al., 2009

is a major driver for GHG emissions reduction. Helping domestic industries become more energy-efficient will lower domestic energy consumption, freeing hydrocarbons in oil-producing countris for export rather than electricity generation. Reducing consumption can also lower peak power demand, directly impacting investment requirements in new power plants.

4. **Address climate change effects and reduce pollution.** Due to global warming, Arab countries may be prone to significant impacts from global climate disruption including decreased rainfall, intensified desertification, increased extreme weather events such as droughts and floods, rising sea level, ocean acidification, biodiversity loss, and even human deaths caused by heat waves. GHG management initiatives will contribute to mitigation and adaptation measures. Mitigating carbon emissions will also indirectly reduce the emissions of air pollutant substances such as particulate matter (PM), nitrogen oxides (NOx), and sulfur oxides (SOx), which threaten public health.

5. **Access financial and technical support.** While a final agreement has not yet been reached, developed nations recognize the need to provide financial and technical assistance to developing countries in order to accelerate their shift to a low-carbon world. Arab countries could benefit from financial support such as the Clean Development Mechanism (CDM) under the Kyoto Protocol (or its successors under future agreements), and nationally appropriate mitigation actions as well as transfer of low-carbon technologies. Developing a low-carbon industry in the region will require the collaboration of relevant public and private stakeholders, in order to ensure that their perspectives, priorities, and concerns are taken into account.

This chapter examines low-carbon economy from two different angles. It takes a national economy-wide, sector-level approach before examining the question from the perspective of a private sector industrial entity.

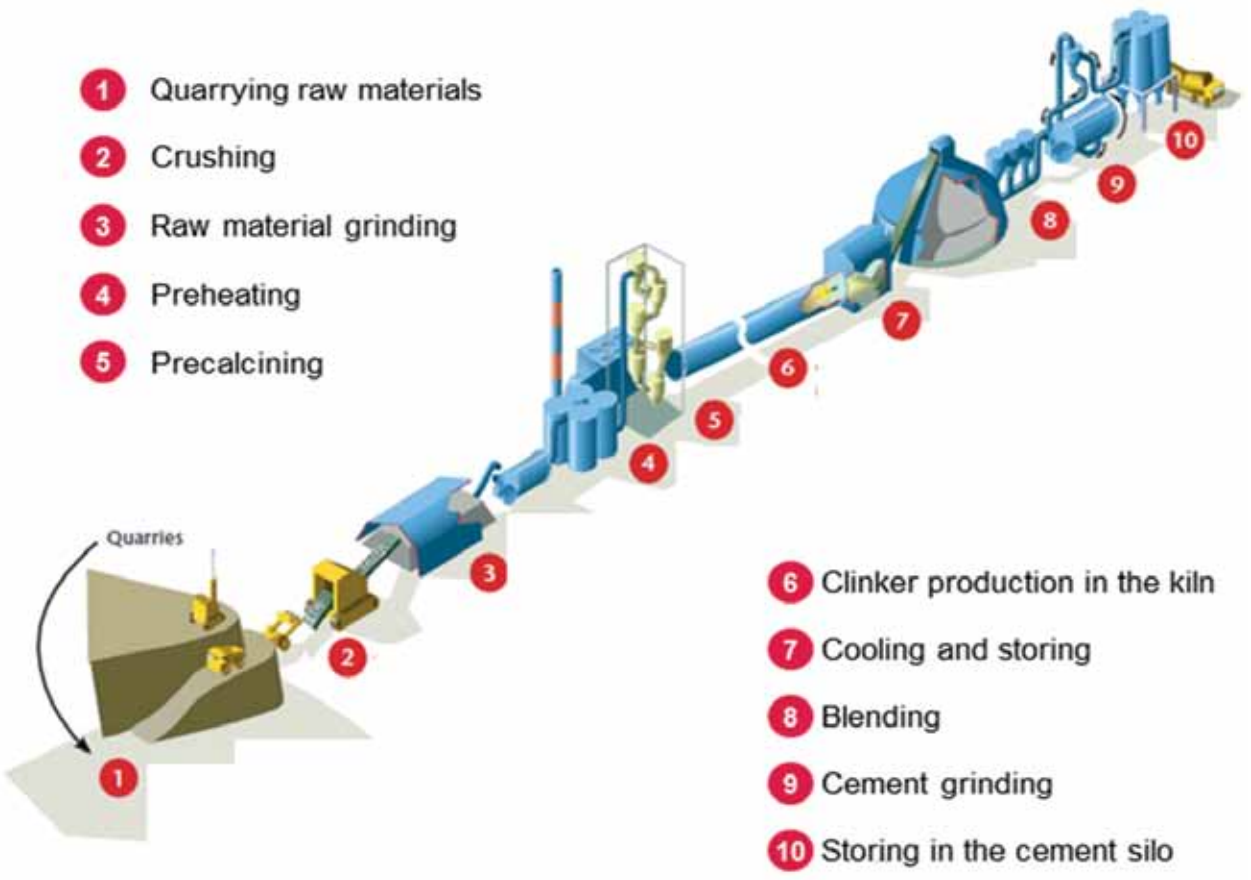
II. A NATIONWIDE LOW-CARBON INDUSTRIAL DEVELOPMENT STRATEGY

Developing a national low-carbon strategy requires a large number of initiatives that can be grouped under three categories: (a) targeting highly energy intensive industries, (b) undertaking cross-cutting energy efficiency initiatives, and (c) manufacturing products for a low-carbon world.

A. Targeting emission reduction initiatives in energy-intensive industries (cement example)

Initiatives that tackle energy-intensive sectors are more likely to have a significant impact on greenhouse gas emissions reduction. For example, examination of a cement production process, illustrated in Figure 2, indicates that significant emissions reduction can be made by increasing energy-efficiency, substituting fossil

FIGURE 2 CEMENT MANUFACTURING PROCESS



Source: WBCSD/IEA, 2009

fuels with alternative fuels, and using lower-carbon materials.

As illustrated in Figure 3, over 93% of CO_2 emission in cement production is due to reaction and fuel combustion processes. Hence, one of the most important measures to reduce emissions is increasing thermal and electrical efficiency by deploying the most efficient production technologies in new cement plants and retrofitting energy efficiency equipment where it is economically viable. This can reduce energy requirement per ton of cement by 20% to 40%, which also leads to a cost advantage to the producer through lower energy costs.

The second method is the use of less carbon-intensive fossil fuels and more alternative fuels in the cement production process. Replacing fossil fuels for kiln heating by alternative fuels can dramatically lower carbon emissions resulting from the process.

Other opportunities can involve substituting carbon intensive clinker with other lower carbon materials that have cementitious properties, and developing alternative materials with properties similar or superior to Portland cement but requiring lower energy requirements.

B. Undertaking cross-cutting energy efficiency initiatives

Initiatives to improve the efficiency of manufacturing processes are applicable in a wide range of industries and can impact, directly and indirectly, competitiveness and employment in thousands of small and medium enterprises. Common examples include the use of efficient motors, efficient heating and cooling systems, and renewable energies.

Motors in machines and pumps, for example, consume a large share of the electricity used in manufacturing industries. Thus, replacing fixed speed motors by high-efficiency variable speed drives saves energy, while producing better performance.

Heating and cooling are required for processes in many industries such as metal fabrication or food processing. Hence, properly insulating processes and cascading heat and cold from one process to the next can save significant amounts of primary energy.

Furthermore, the relatively low-grade heat used by many industries can be generated from waste heat sources or from renewable sources such as solar or geothermal energy.

It is important that Arab governments support such initiatives with adequate financial incentives, particulalrly given electricity's low prices that prevail in many countries. The incentives will be more than offset by the reduction in peak load requirements as well as by freeing hydrocarbons resources for export or other value-adding opportunities (e.g., petrochemicals).

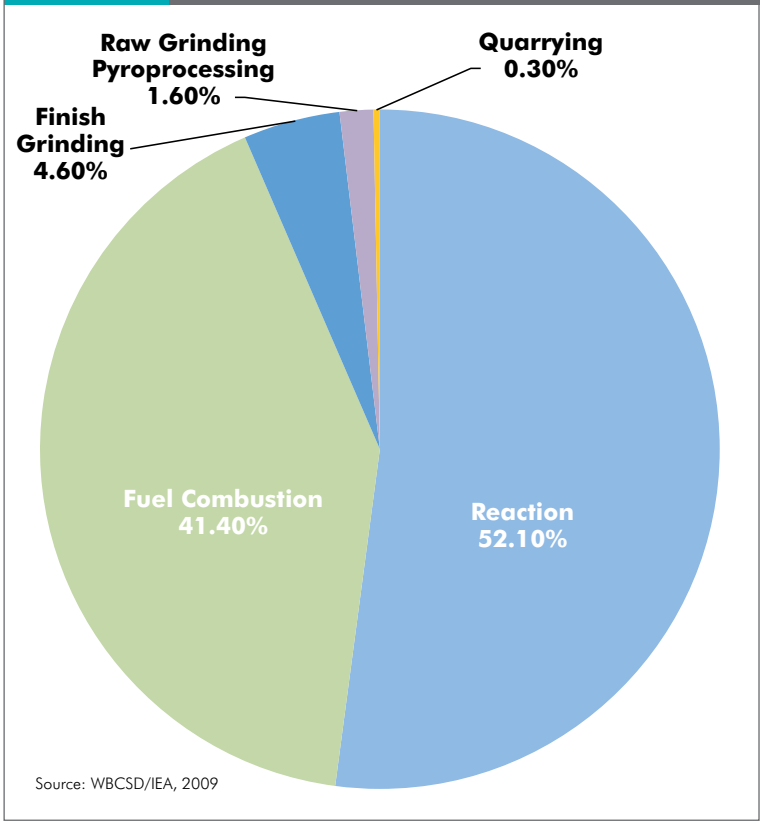
The financial incentives required to support energy efficiency initiatives in the industrial sector can range from grants to support the deployment of efficient equipment to rebates on the electricity bills, among other measures.

C. Manufacturing products for a low-carbon world

Initiatives to manufacture products for a low-carbon world can be divided into those aiming to upgrade existing industries and others that create and grow new industries to produce low-carbon content products, renewable energies, or energy efficiency equipment.

In terms of upgrading existing industries, a number of measures can be used to stimulate the local market for energy-efficient products, providing the right incentives for private sector players. Governments can impose minimum energy and water effciency standards that products must meet if they are to be sold in the country. For example, efficiency standards

FIGURE 3 CO_2 EMISSIONS FROM CEMENT PRODUCTION



Source: WBCSD/IEA, 2009

on air-conditioning devices would have a significant impact on energy consumption as well as on power peak load requirements. Alternatively, utilities can offer rebates to consumers buying new appliances that fulfill certain minimum efficiency standards, or even replace old, inefficient appliances for a nominal fee. If the efficiency improvement potential is large enough, financial support for early retirement of appliances and devices can be beneficial from the perspective of both the consumer and the utility. This is particularly the case in countries where electricity prices are supported by the government.

Rising electricity tariffs for end-consumers, or structuring them in such a way as to make overconsumption more expensive, can make the business case for buying new, more efficient appliances much more attractive. Labeling or rating systems make the energy consumption of appliances and devices more transparent to the consumer and will encourage a shift to more efficient appliances by making energy efficiency a part of buyers' decisions.

DUBAL DX TECHNOLOGY

Ali Mohamed Al Zarouni

Driven by a quest for continuous improvement and ongoing innovation, Dubai Aluminium Company Limited (DUBAL) has developed advanced reduction cell technologies that improve production efficiency, reduce energy consumption, and enhance environmental performance for more than 25 years. This commitment to developing its own smelting technologies in-house that can compete with similar technologies on the world market in terms of productivity, capacity, and efficiency, while maintaining the highest standards of environmental performance culminated most recently in introducing the proprietary DX Technology.

Developed in 2006, then further refined through extensive research and development, the DX Technology was deployed in a dedicated 40-cell demonstration pot-line at DUBAL's Jebel Ali smelter complex and commissioned in 2008. Over the first two years of operation, the amperage of these cells was successfully stepped up from 340 kA to 380 kA, with stable results, thereby demonstrating the capability of this technology to operate at high amperage levels.

Consolidated at 380 kA, world-class performance standards are consistently achieved by the DX Technology demonstration pot-line in terms of current efficiency (95.45%), net specific energy consumption (13.2 kWh/kg Al), reduced net carbon consumption (< 0.415 kg C/kg Al) and pot emissions. With perfluorocarbons (PFC) emissions of 0.010 CO_2eq ton/ton Al produced, DX Technology has achieved a new benchmark. The DX Technology now ranks among the most efficient aluminium reduction-cell technologies available. And with continual improvements being implemented, the DX Technology is rapidly becoming established as a sector-leading innovation.

DX Technology has also been licensed to, and installed in, the first phase of the green-field Emirates Aluminium Company Limited (EMAL) smelter complex at Al Taweelah, Abu Dhabi, which was commissioned in 2010. Currently operating at 353 kA, the 756 cells at EMAL Phase I consistently surpass projected performance levels by delivering current efficiency greater than 96.6% and achieving net specific energy consumption of less than13.0 kWh/kg Al.

Reflecting DUBAL's commitment to continuous improvement, ongoing research and development has led to the redesign of DUBAL's DX Technology cells to enable operation at even higher amperages. Five new generation cells, built in the pilot line at DUBAL's Jebel Ali site, have been operating at 420 kA since August 2010. The improved technology — known as DX+ Reduction Technology — is underpinned by the proven, inherently robust DX reduction technology.

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Educational campaigns focusing on the environmental costs and benefits of more efficient devices can also be used to raise consumer awareness and influence consumption and producion patterns. Education and awareness campaigns can be powerful, if they bring trusted stakeholders in transmitting a clear message. For example, the 'Heroes of the UAE' (2009) is jointly developed by The Emirates Wildlife Society in association with the Worldwide Fund for Nature (EWS-WWF) and The Environment Agency-Abu Dhabi, and is endorsed by the Ministry of Energy, the Ministry of Environment and Water, Masdar, and the Abu Dhabi Water and Electricity Authority. Over 45,000 energy-saving bulbs have been handed out to residents across the UAE in three months as part of a nationwide campaign to illustrate simple and effective ways to reduce energy consumption, air pollution, and government expenditures at home.

To create and grow new industries, a coordinated effort from the government is required to support the private sector. This involves:

1. Putting in place the appropriate institutional setting. In many countries in the region, there is no clear ownership at the government level of issues related to renewable energy. Governments must appoint and empower an entity to lead the development of policies and regulations and follow up on their implementation.

Strong financial support—in the form of guaranteed markets for renewables or similar instruments—is not sufficient to get renewable projects off the ground. Numerous administrative barriers unintentionally block renewable energy projects: wind turbines often surpass existing height limits for buildings, projects can face excessive permit requirements, limited cooperation from local utility companies in providing

ALBA RECYCLES WATER FOR LANDSCAPE IRRIGATION

At the Aluminium Bahrain (Alba) plant complex, trees, flowers, and shrubs are scattered over a 240,000 m^2 area. An artificial oasis with an estimated area of 90,000 m^2 was created in 2009, containing many types of plants and trees. The Oasis is surrounded by palm trees, fruit trees, shrubs, and other shade trees. There are more than 100 native palm trees, more than 600 Washingtonian trees, and approximately 1,000 other lush flowers and shrubs.

The oasis is irrigated using water that is recycled from various parts of the Alba plant. First, recycled water is pumped into a lake located at the entrance of the oasis. A portion of the lake water is recycled from the wastewater treatment plan, and another portion is drained from the cooling water towers. The water is filtered naturally in a bed of gravel and with the aid of plants. Lake water is used for irrigation at a rate of 500 m^3 per day.

The lake supports aquatic species such as turtles, golden fish, and other fish species. During the winter season, migratory birds such as flamingos, sea gulls, and water chickens, have been spotted by the lake.

Expansion plans call for utilizing blow-down water from the power and utility sections at a rate of 300 m^3 per day, to be used for irrigating more green spaces. The use of recycled water for irrigation reduces the demand for freshwater production as well as the associated costs of energy use and environmental degradation.

grid connections, and overlapping jurisdictions of multiple administrative bodies. An entity that oversees and coordinates the regulation of the renewable energy sector can help clear the administrative thicket.

2. Developing a favorable policy and regulatory framework. In most Arab countries, the regulatory environment is such that national utility companies define power generation requirements, which they are mandated to meet at the lowest possible cost. Accordingly, their delivery models usually involve private developers under independent water and power producer (IWPP) schemes. This procurement model is geared toward large-scale, conventional power stations, which meet specific generation requirements such as dispatchability. Furthermore, IWPPs involve complex contracts justified by the scale of the investments and the nature of the financing involved.

Renewable energy projects, particularly small-scale ones, cannot be readily integrated into this model. It is not only that renewable energy projects can not meet dispatch requirements, but for them to be viable and bankable, they must be able to rely on revenue streams that are independent of demand, and commensurate with the investments required. Accordingly, Arab countries must make substantial changes in the regulatory framework to create incentives that would kick-start renewable energy investments.

Policymakers may want to consider investment grants, research and development (R&D) grants, tax incentives, renewable portfolio standards (RPS), feed-in tariffs (in which utilities are obligated to purchase renewable energy at a specified price), and tendering schemes that result in competitive bidding for renewable developments. In Denmark, for instance, a combination of feed-in tariffs and investment grants has been instrumental in driving the development of a renewable generation.

WASTE HEAT RECOVERY AND POTABLE WATER PRODUCTION FROM THE CALCINATION OF GREEN PETROLEUM COKE

The coke calciner plant at the Aluminium Bahrain (ALBA) complex was commissioned in 2001 with a total installed capacity of 450,000 metric tons per year (MTPY) of calcined petroleum coke (CPC). The plant contains two calcining units of identical capacity. Waste heat from the calcining units is recovered and used as a source of energy for operating two boiler units. The steam produced by the boilers is used by 4 independent multiple-effect distillation lines designed to produce 41,000 cubic meters of potable water per day.

The calcination of green petroleum coke (GPC) takes place in rotary kilns via an exothermic reaction, releasing a significant amount of heat upon the combustion of volatile combustible matter (VCM) and carbon.

Flue gases from the rotary kilns, at a pressure of 25 bar and 1200 °C, are directed to the boilers, where heat is recovered and used for generating steam. The flue gas exits the boiler at 175 to 210 °C. The boiler steam is then used to provide heat for the desalination of seawater using multiple-effect distillation (MED) technology. The MED units operate at a capacity of 41,000 m^3/day of potable water. The largest share of potable water is supplied directly into the water mains of the Ministry of Electricity and Water at a rate of 32,000 m^3/day. About 6,000 m^3/day of water is directed to the ALBA complex, while the remaining balance is distributed to miscellaneous customers.

3. Developing R&D capabilities and a sufficient talent pool. The energy efficiency industry needs a skilled workforce of technicians, designers, and engineers. There is a global shortage of such skilled workers, and the problem is even more acute in Arab countries, since its relatively small industrial base has not created a significant pool of trained workers who could be shifted to such tasks.

In addition, this sector depends heavily on R&D for advancements in materials, technology, and implementation. Pioneers in this sector are often located in close proximity to world-class research institutions. Arab countries currently lack such research institutions, although they have started to address this shortcoming through a number of regional initiatives such as the Masdar Institute of Science and Technology (MIST), King Abdullah University of Science and Technology (KAUST), and King Abdullah City for Atomic and Renewable Energy (KA-CARE).

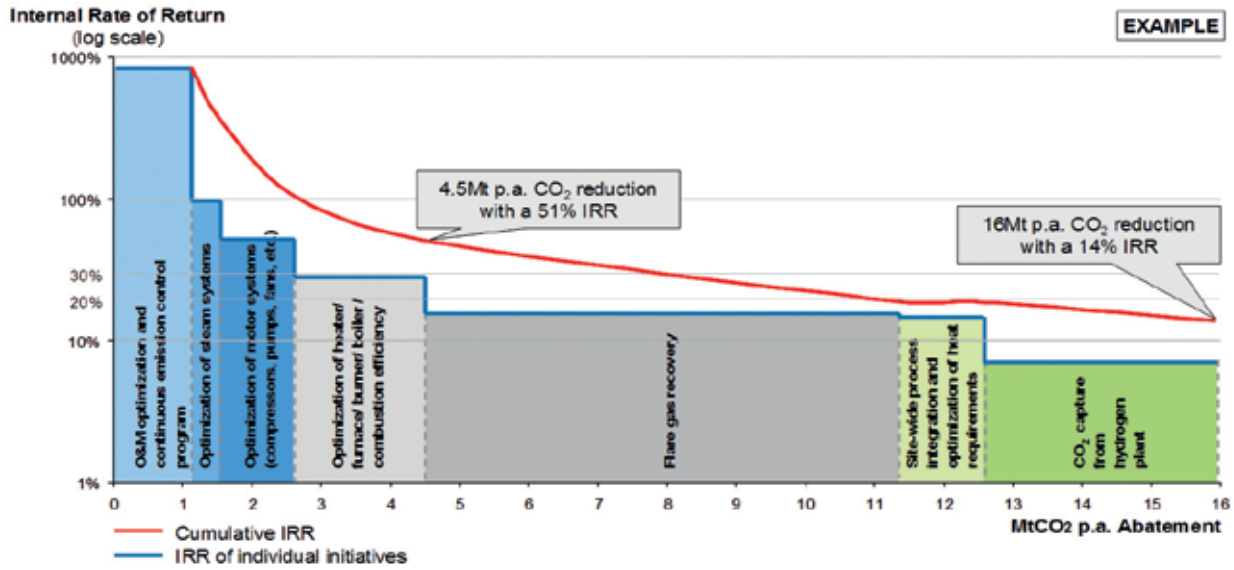
III. REDUCING EMISSIONS WHILE MAKING PROFIT

Contrary to popular belief, addressing GHG emissions can be profitable. One national oil company, for example, identified the potential for a 43 percent reduction in emissions with a net present value of several billion U.S. dollars. For carbon-intensive industries, such as oil and gas, chemicals, and utilities that take a proactive approach to GHG management, the benefits can extend beyond profit.

1. Long-term competitiveness of hydrocarbons. GHG abatement measures in oil and gas operations reduce the carbon footprint of these fossil fuels. Accordingly, the implementation of a GHG management strategy contributes to the long-term competitiveness of oil and gas as the world transitions to low-carbon energy sources.

2. Energy efficiency returns. Energy efficiency measures, central to many GHG emissions management initiatives, generate direct cost savings by reducing fuel consumption. In many cases, energy efficiency measures pay for themselves and some are very profitable, with payback periods of less than three years. National oil companies specifically have an additional opportunity at the broader national level: they have much to gain from reductions of GHG emissions in their respective economies as this implies lower capital investments to

FIGURE 4 **EMISSIONS REDUCTION (MT P.A.)* INVESTMENT CURVE FOR A NATIONAL OIL COMPANY IN THE MIDDLE EAST**



* Mt p.a.: Metric ton per annum
IRR: Internal rate of return
Source: Booz & Company analysis, 2011

meet local energy requirements and increased crude available for export. Accordingly, national oil companies in the region should drive the implementation of energy efficiency measures not only to improve the economic and environmental performance in their own operations, but also in the power and transport sectors of their countries.

3. Access to carbon finance and technical support. The clean development mechanism (CDM) under the Kyoto Protocol allows qualifying emission reduction projects in developing nations to benefit from financial and technical support. To date, CDM has remained relatively unexploited in the Middle East. With a large number of CDM methodologies already in place for energy efficiency and alternative energy applications in the oil and gas, petrochemicals, and utilities sectors, there is great potential for companies to take advantage of carbon finance support.

4. Improved image. With GHG emissions management programs, companies in carbon-intensive sectors will demonstrate their commitment to reducing emissions and help deflect increasing public scrutiny about their contributions to climate change.

Although it may be tempting for companies to view GHG emissions management initiatives strictly as part of their corporate social responsibility agenda, these wide-ranging benefits point to an economic imperative as well, and one that should not be overlooked or underestimated. To capture these benefits, companies in Arab countries should adopt a systematic and methodical approach to reigning in their emissions, articulated in three key steps:

i. Choosing a strategic course

Defining a strategic position should be a company's first major step in tackling GHG emissions because that will guide its course of action, as well as its level of involvement in driving the low-carbon agenda at the national level. Setting the right course, though, takes an understanding of the company's baseline emissions[1], which will help identify the biggest contributors and compare emission levels to international benchmarks.

Once the company has established its emissions baseline, its leadership should articulate a vision for dealing with its GHG footprint. Through this process, companies are likely to settle on one of four broad positioning options for aligning their strategic vision with the right set of emissions reduction initiatives:

1. Compliant. Companies that fit under this category would implement GHG emissions reduction measures solely to comply with the requirements of national and international regulations. Initiatives designed for this purpose are not governed by a programmatic approach and represent the bare minimum of what is required.

2. Efficient. This positioning would account for companies seeking to go a step further than basic compliance by improving the efficiency of their operations and attempting to benefit from carbon finance support. They would target investments in readily available and robust technologies, typically at the equipment level, with short payback periods.

3. Enlightened. This category applies to companies aspiring to be leaders in their region in emissions control. It involves complex but tested technologies, typically at the process and plant levels. Understanding and implementing these activities require significant capabilities and knowledge. Under this positioning, companies would collaborate with other energy stakeholders at the national level on selected GHG emissions reduction initiatives with the aim of reducing national fossil fuel consumption. Examples of such initiatives might include a national oil company supplying the utility sector with low-emissions fuels or collaborating with utility sector stakeholders to implement alternative energy projects.

4. Differentiated Leader. The greatest benefits in terms of emissions reduction would go to those companies that seek to establish best-in-class GHG emissions reduction performance and innovation on a global scale. Many of the emissions reduction solutions in this category would be considered cutting-edge technologies, offering companies the opportunity to take a competitive position in generating intellectual property in this area. Additionally, companies that are ready to assume a leadership role in their country's emissions-reduction efforts can establish themselves as national champions by working with the country's environmental agencies to develop a detailed national carbon inventory and low-carbon development plan. In this role, companies would support national initiatives to establish the institutional setting for accessing international carbon finance support and contribute to setting energy efficiency standards and developing initiatives in other carbon-intensive sectors, such as the implementation of alternative energy projects.

ii. Developing a greenhouse gas reduction program

Once companies establish their vision for GHG emissions management at the corporate and national levels, they should identify potential emission reduction initiatives across the value chain. These opportunities can be grouped into five broad categories:

1. Continuous operations and maintenance (O&M) improvements. Companies may achieve emissions reductions and fuel savings through improved process controls and direct inspection and maintenance programs. For example, in the oil and gas sector, this includes systematic de-fouling (removing unwanted material deposited on solid surfaces using chemical solutions) and operational measures leading to reduced

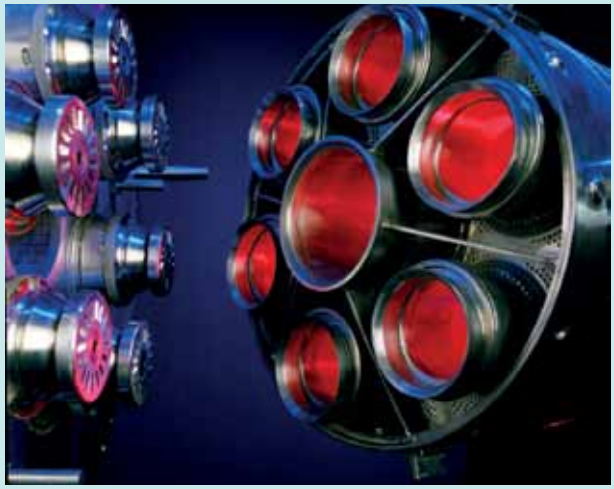
REDUCING AIR POLLUTION IN RAS LAFFAN INDUSTRIAL CITY, QATAR

One of the world's leading liquefied natural gas (LNG) producers, RasGas Company Limited (RasGas), is proactively taking emissions reduction measures to meet the requirements and regulations set by Qatar's Ministry of Environment. As a result of its leadership, RasGas's nitrogen oxide (NOx) emissions reduction program is ahead of the milestones set by the government, making it a true pioneer and contributor to safeguarding the environment.

When RasGas learned in 2003 that the government was implementing new regulations the following year, it turned to its global technology partner General Electric (GE) to find a solution which supports both the government's initiative as well as its business objectives. GE provides gas turbines to the company.

With the objective of achieving both full compliance to the new environmental policy and ensuring maximum performance of the gas turbines, GE proposed applying its dry low NOx (DLN) combustion technology to the installed units. GE's advanced DLN1 combustion system allows gas turbine operators to reduce the amount of emissions without the injection of diluents.

GE and RasGas embarked on the retrofit project in 2008. To fit RasGas site conditions and requirements, the project required the customization of the technology. To date, GE and RasGas have retrofitted seven Frame-6 and two Frame-7 gas turbines.



As a result of the hard work, the gas turbine NOx emissions, which were in the range of 70 parts per million (ppm) when the project started, are now achieving a reading of 10-15 ppm on the retrofitted gas turbines. In addition, according to RasGas, the projected reduction in NOx emissions following the retrofit of the remaining Frame-7 gas turbines is almost 50%, from around 30,000 tons in 2007 down to approximately 15,000 tons by 2014. RasGas is taking the lead on its environmental commitment to help Qatar and the region meet their vision for economic and environmental sustainability.

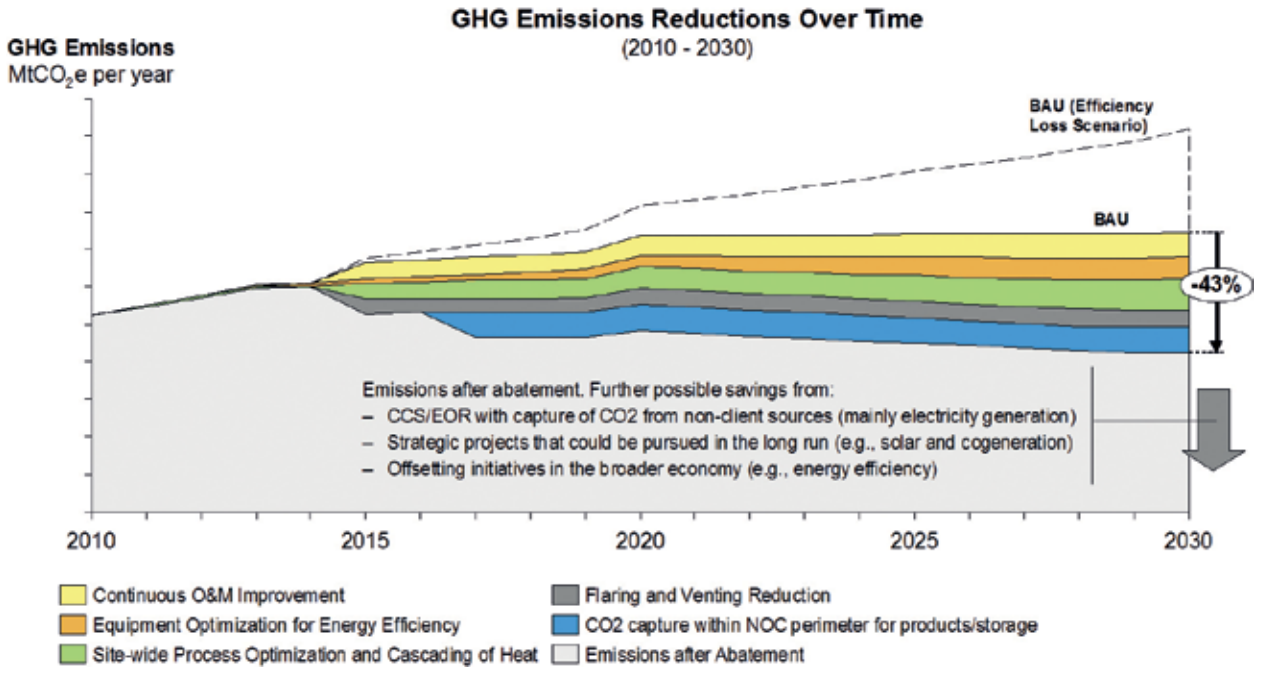
emergency flaring. Such improvements require little capital investment, yet have the potential to yield emission reductions of as much as 10%.

2. Improving equipment efficiency. These initiatives target GHG emission reductions by improving the efficiency of equipment such as heaters, burners, boilers, compressors, turbines, and motor systems. In refineries, such equipment typically accounts for 65% of emissions. At one refinery, optimizing the combustion efficiency of heaters, burners, and boilers required an investment of approximately $120 million with a potential investment rate of return of nearly 30% and a potential payback of less than 3 years.

3. Reducing heat requirements through process improvements. Companies in process industries can realize energy efficiency improvements via the optimal use of heat and optimization of steam systems. To achieve this, they will need to conduct pinch analysis—i.e., systematic analysis of energy flows and use in processes, which helps determine the minimum energy a process requires.

4. Flaring and venting reduction. In the oil and gas and petrochemicals industry, venting is a major source of direct methane emissions that often results in losses of significant value. Hydrocarbon vapors often have higher heat content than pipeline quality natural gas, making them more valuable than natural gas. Vapor recovery systems (VRS), which can capture up to 95% of hydrocarbon vapors, can capture this value by allowing the vapors to be resold, used on-site as fuel, or fed to processing plants to recover valuable natural gas liquids. Industry experience reveals that the installation

FIGURE 5 **USING ALL AVAILABLE MEASURES CAN REDUCE EMISSIONS SIGNIFICANTLY**



$MtCO_2e$: Metric ton carbon dioxide equivalent
BAU: Business-as-usual
CCS/EOR: Carbon capture and storage/Enhanced oil recovery
Source: Booz & Company analysis, 2011

of VRS can be quite profitable. In one example, an independent oil company installed VRS at two locations at a cost of $200,000 and saw its investment recouped in less than two months due to the high value of the gas recovered.

5. Structural initiatives. While the initiatives enumerated above can be launched unilaterally, companies may also selectively pursue more challenging and complex projects that involve multiple stakeholders or business units. These initiatives, such as cogeneration with grid tie-up and the use of residual heat, the application of solar thermal for providing heat to processes, and the development of solar power to offset power consumption, offer great potential for emissions

IMPROVING THE ECO-EFFICIENCY OF THE STONE AND MARBLE INDUSTRY IN JORDAN

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The stone and marble industry is one of the major contributors to Jordanian economy; in 2008 it contributed 40 million Jordanian Dinars (JD) to the country's gross domestic product (GDP). The sector employs 7500 people and exports stone and marble products to international markets. However, the industry is also a major water consumer. The production process uses water and generates a white slurry wastewater containing limestone particles. Most factories apply a basic settling technique to recycle and reuse treated water. However, the settling process is inefficient, leaving behind large quantities of slurry (containing 70% water), which are dumped in various sites.

In order to address waste dumping and improve the recovery of water, the Jordan Business Alliance on Water (JBAW) conducted a study to evaluate the effectiveness of implementing a treatment and reuse system for the slurry in different locations. JBAW is a recent initiative established to create private, public, and community partnerships to improve the management of water resources in Jordan. Under the current initiative, 3 locations in Amman, Irbed, and Mafraq have been selected as sites for the pilot projects. This set up was necessary because stone and marble workshops exist in clusters of micro enterprises around many cities in Jordan.

The JBAW assessment revealed that significant savings could be obtained. Water savings would reach 350,000 m^3/year, amounting to cost savings of about 1 million JD; savings in transport would be approximately 1.5 million JD, while reducing CO_2 emissions by 280 ton annually.

The yearly cost of the treatment process (including initial investment, operation, and maintenance) is estimated at 1.7 million JD. Thus the net financial benefit is equal to about 0.8 million JD annually, which makes the water recovery process economically viable. It has also been acknowledged that the local municipalities have expressed their willingness to contribute to the project by providing land, while the chamber of industry will provide the umbrella for overall project implementation in addition to contributing to covering the purchase cost of the treatment systems.

The social benefit of the project is reflected in water resource recovery, which would improve water supply to households in the communities where stone enterprises are located. In addition, dumping slurry water on random sites can now be avoided. These transformations are expected to improve the quality of life for communities.

In a country with a very low annual per capita share of freshwater, improving the eco-efficiency of industrial water use becomes a strategic business decision with economic, social, and environmental implications. Increased water efficiency by micro-enterprises in the stone and marble sector will reduce costs, lift profit margins, and improve the sector's economic competitiveness, while contributing to more sustainable patterns of water management.

** Jordan Business Alliance on Water (JBAW) is a joint initiative chaired by HRH Prince Faisal bin Al Hussein and supported by the Ministry of Water and Irrigation, Ministry of Planning & International Cooperation, Jordan Chamber of Industry, American Chamber of Commerce, US Agency for International Development (USAID), Deutsche Gesellschaft fuer Internationale Zusammenarbeit (GIZ) funded by the German Federal Ministry of Economic Cooperation and Development (BMZ), and the World Economic Forum (WEF).*

reductions. Additionally, national oil companies (NOC) can consider carbon capture and storage (CCS) with enhanced oil recovery (EOR)[2], while companies in the petrochemicals sector can explore carbon conversion, involving the use of captured CO_2 as feedstock—for instance, for urea and methanol processing.

Once companies have identified the extent to which the above opportunities are applicable to their operations, they should prioritize them based on the tradeoff between their emissions reduction potential and their cost and difficulty of their introduction. This ensures that efforts are focused on those opportunities with the greatest potential for emissions reduction in the context of practical capacity constraints.

Companies must then analyze in greater detail the initiatives that make the shortlist to determine

OPINION

LOWER CARBON ECONOMY-IMPLICATIONS FOR DEVELOPING COUNTRIES

Mohamed El-Ashry

In many forums around the world we are having incomplete public debates about climate change. As we should, we are trying to address questions about caps on pollution and timetables, cost of action and inaction, carbon markets and allocations, but are not giving much attention to the principal, long-term objective—building a robust clean energy economy. While climate policy to prevent dangerous global warming is not about sacrifice or trade-offs, this is a golden opportunity to address simultaneously the related challenges of finance, jobs, energy, health, water, and food that the world has been facing recently.

Rebuilding the global economy beyond the financial crisis on the foundation of low-carbon energy will create millions of jobs—what some are calling "green collar jobs." The number employed in climate-related activities worldwide since 2004 has more than doubled from just over 1 million to about 2.4 million. But it will take policy and political leadership to unleash the creativity and investment of entrepreneurs in solving these great challenges. Smart policy would treat low-carbon energy as a strategic asset and an opportunity to drive innovation and new investment across national economies. As the financial crisis has shown, government action and government policy are crucial to restoring order on the economic front. Likewise, government action and government policy are crucial for addressing climate change and for pursuing a low-carbon and sustainable future.

According to the International Energy Agency (IEA), with no new policies, world primary energy demand and related CO_2 emissions will grow by almost 50% by 2030. About 80% of that growth will be in developing countries, with China and India accounting for over half of this incremental demand. According to McKinsey and Company, 77% of the world's future infrastructure needed by 2030 is yet to be built and most of it will be located in developing countries.

Setting in place a clean energy infrastructure, with an emphasis on renewable sources, makes economic and environmental sense. The technical potential of renewable energy is huge and is several times the current total energy demand, especially in electricity generation. The renewable sector has the potential to stimulate economies, create millions of jobs, cut greenhouse gas emissions and other pollutants, improve energy security and provide energy access to those who are currently lacking it.

The renewable energy sector is one of the fastest growing sectors in the world. Overall investment in renewable energy and energy efficiency has increased dramatically in recent years, up by more than four times globally and by 14 times in developing countries between 2004 and 2007. In 2008, investment in renewable energy defied the global recession, growing by about 5% from 2007 to $155 billion. One of the most remarkable milestones for 2008 was that businesses selling low-carbon goods and services now generate more revenue than the aerospace and defense sectors combined, making the sector one of the new lynchpins of the global economy, according to research by HSBC. Similarly, more than 50% of total added power capacity in 2008 in both the U.S and Europe was renewable—more than new capacity for oil, gas, coal, and nuclear combined.

According to a survey by New Energy Finance and Deutsche Bank, 75% of 106 institutional investors—including pension, banking, and insurance funds with $1 trillion in assets under management—expect to increase their involvement in clean energy and other low carbon investments by 2012. Renewable energy was by far the most popular investment theme for respondents, with 97% expressing interest, while energy efficiency was the next popular theme with 64%. Not a single asset owner participating in the survey said that they were less likely to invest in clean energy now than they were 12 months ago.

their investment requirements, economic attractiveness, and potential risks. This assessment should also determine eligibility for carbon finance support and identify whether relevant CDM methodologies exist. Shortlisted initiatives may be mapped on an emissions reduction investment cost curve to capture the returns associated with each opportunity, as illustrated in Figure 4. As indicated by the investment curve, the most profitable opportunities feature returns well above the typical returns expected for capital projects and make the overall economics of GHG emissions management very attractive at the portfolio level.

In the aggregate, the opportunities available to companies in the process industries in Arab countries can potentially reduce emissions by more than 40%,

The trends in the renewable energy industry are encouraging but will need significant scaling up to match the size of the challenges we face. A number of developing countries are leading the way. For example, China has adopted a target whereby 30% of its total energy supply in 2030 will come from renewables. India has a target of 20,000 megawatts from solar energy by 2022, the biggest target for solar energy anywhere in the world. They are constructing the largest solar power complex of 3,000 megawatts at $10 billion in the state of Gujarat.

In the Arab region, there are also a number of promising developments, even though its investment of $2.6 billion in renewable energy and energy efficiency was only a fraction of Asia's $24.2 billion and South America's $12.3 billion. Last year, Qatar announced it was investing about $240 million in the Qatar-UK Clean Energy Technology Fund. Kuwait is planning a tender in 2010 for a solar energy plant and is aiming to generate 5% of its electricity from renewable sources by 2020. Egypt, in addition to a number of wind energy farms, is building a solar thermal power plant with support from the Global Environment Facility (GEF). Tunisia has adopted a renewable target of 10% share of its total primary energy by 2011,and Abu Dhabi has an electricity share target of 7% by 2020 and is pioneering a zero-carbon city, Masdar, which aims to be completely carbon neutral, and which promises to put the region in the spotlight by becoming a center of innovation. It is worth mentioning that the headquarters of the new International Renewable Energy Agency (IRENA) will be based in Masdar.

On the other hand, while 64 countries around the world had some type of policy to promote renewable energy, Algeria and Tunisia are the only Arab countries to have adopted promotion policies. For example, Algeria has a policy for feed-in tariff and with Tunisia they have policies for investment and tax credits, while Egypt is engaged in developing feed-in policies.

The huge unfulfilled potential of renewable energy in the Arab region is attracting the attention of Europe, and European investments. The Mediterranean Solar Plan is under implementation and will produce 20, 000 megawatts of renewable energy from North Africa by 2020. $6 billion have been committed to Morocco alone. Recently, a consortium of European corporations and investment banks, including Munich Re, Deutsche Bank, and Siemens, has announced a proposal to develop a massive amount of solar thermal generating capacity in North Africa, much of it for export to Europe. In total, DESERTEC could easily exceed 300,000 megawatts, which is roughly three times the electrical generating capacity of France. DESERTEC is a much longer-term plan than the Mediterranean Solar Plan.

Where does this leave the Arab region? Is it enough to wait for the rest of the world to innovate and import the technologies at some later date? Or should the Arab countries join hands together, out of self interest, to pool human and financial resources as well as to catalyze foreign investment and be a leader in the clean energy field. Investing today in the development and deployment of clean technologies will not only help some countries in diversifying their energy sources and in achieving energy security. It will also create jobs, promote innovation, and improve people's health and the environment. As the world moves to a low carbon economy, there will be a competitive advantage for those who embrace clean technologies first.

The AFED report addresses the impacts of climate change on the Arab region and recommends policies and actions for adaptation to climate impacts. But the Arab region also has a great opportunity to become a leader on the mitigation front, especially in the area of renewable energy—not because it has an obligation in the short-term to reduce emissions, but because it would carve for itself a piece of the future now.

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with even greater potential when factoring in major structural opportunities such as carbon capture and storage, as illustrated in Figure 5.

Designing the GHG emissions management program to implement emissions-reduction initiatives in phases will allow companies to focus first on "quick win" projects with short implementation lead times, accelerated payback periods and near-term emission reduction potential. By prioritizing projects in this way, companies will be able to generate early positive cash flows to fund more capital intensive projects later on, as well as gain greater insights in setting annual emission reduction objectives. Importantly, achieving quick wins will also boost confidence in such projects by raising awareness of their successes.

iii. Establishing processes and infrastructure

Once companies have established their strategic course and the design of the program, they will need to act upon three critical aspects of their business to lay the foundation for the program's successful implementation by: (i) developing an operating model, processes, and capabilities for GHG emissions management, (ii) institutionalizing GHG emissions management through active monitoring and market-based transfer pricing policies, and (iii) managing communication about GHG emissions strategy implementation and results.

Designing an operating model for GHG management involves defining the activities, processes, and organizational structure required to govern and implement the program, including the mechanisms to allocate and approve funding for chosen initiatives. A key challenge here resides in achieving a balance between central consolidation and control on one side, and sufficient latitude for business units to manage their respective parts of the GHG emissions reduction program on the other. Companies will also have to ensure that they have the right set of capabilities to deploy the GHG emissions management strategy. For instance, in order to fully leverage carbon finance mechanisms, companies will need to develop specific capabilities related to CDM project identification, registration, evaluation, development, and implementation. Carbon finance is a world unto itself, and many companies don't have the in-house expertise required to manage the process for obtaining CDM credits. In particular, the ability to demonstrate CDM additionality by analyzing investment barriers is critical. Overall, workforce training and recruiting programs focused on building both foundational and incremental skills are fundamental to building an effective GHG management team.

The second key aspect companies will need to address is the institutionalization of GHG management, including the ongoing monitoring of GHG emissions. After companies have established an emissions baseline, they will need to maintain accurate carbon inventories to

regularly assess the effectiveness of their GHG emissions reduction management strategy or to identify areas in need of improvement. Another component of the institutionalization of GHG management is the adoption of market-based transfer pricing policies, as fuel and electricity prices are key inputs in conducting cost-benefit analyses of GHG management projects. When these costs are subsidized, as is often the case in Arab countries, they distort this analysis and can deter companies from making investments that would have been profitable when factoring in opportunity costs.

Accordingly, companies should review transfer pricing policies and set evaluation guidelines to ensure that their assessments are based on the real market value of these inputs. The last key component of institutionalization is the integration of GHG management into the company's performance management framework. Companies should adapt their performance management framework to ensure that their operations are aligned with the overall GHG management strategy. This is done by setting implementation milestones early in the deployment phase, and establishing results-based indicators to monitor on-going performance in emission reductions against target objectives. The performance management system should be tied to existing incentive structures to ensure that company leaders and employees are motivated to drive the strategy's implementation.

Finally, a comprehensive communication plan is necessary to engage employees and external stakeholders. Internally, the plan should seek to educate, enlist, and reward participants, including company leadership, staff, contractors, and business partners. Internal communications may involve written publications such as newsletters, but also more participatory forums such as workshops and town hall meetings. Companies should gear external communications toward raising national awareness about the implications of climate change and the importance of energy efficiency. Communication should celebrate successful emission reduction initiatives. In any communication, messages should be carefully constructed to avoid compromising the company's ability to qualify for CDM assistance.

IV. CONCLUSION

Governments and companies in carbon-intensive sectors in Arab countries can turn the growing global pressure around climate change into an economic opportunity. By adopting a systematic and programmatic approach to managing their greenhouse gas emissions, they can support the long-term sustainability of the industrial sector, while improving their economic, competitive, and environmental performance.

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Further reading

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NOTES

1. The first challenge: Establishing a baseline

Before companies can begin identifying and investing in GHG emissions reduction initiatives, they need to obtain a proper and exhaustive inventory of their GHG footprint. A detailed baseline of emissions allows companies to identify areas with a high potential for emissions reduction, based on comparisons with best-in-class benchmarks. An emissions baseline also forms the basis for deriving a "business as usual" scenario, which projects future emissions in the event that no actions are taken. Such scenarios make it easier to set goals for emission reductions and also serve as a valuable reference point for monitoring performance on an ongoing basis.

The raw information contained in such an inventory is often already available, but companies don't generally aggregate it because they are not required to do so. To gain greater insights about emissions reduction potential, companies must distill this data in a well-structured baseline for every subsidiary or business unit. They should also delineate between direct emissions (e.g., combustion, flaring and venting, and fugitives) and Scope 2 emissions resulting from imported sources (e.g., electricity and water). *

Companies can compile two types of emission inventories: equity-based and control-based. For pragmatic reasons, companies may choose to use a control-based approach, as they will have more power to implement changes in subsidiaries in which they own a controlling stake.

2. Carbon capture and storage and enhanced oil recovery

Carbon capture and storage (CCS) encompasses a variety of technologies to capture, transport, and sequester carbon dioxide emissions. Countries around the globe are pushing ahead with investments in CCS in the hopes of enabling commercial scale deployment by 2020. Governments are dedicating a collective US$15 billion each year to fund more than 200 projects and induce investments from the private sector.

Leading oil companies should assume an important role in the development of CCS, as they are in a unique position to leverage their upstream capabilities (e.g., geological characterization and overall reservoir management) for the storage of carbon dioxide in oil and gas reservoirs and other geological formations.

Investing in CCS projects has become more attractive since it was included, by the Climate Summit in Cancun in December 2010, with the technologies eligible for support under the Clean Development Mechanism.

Enhanced oil recovery (EOR) storage represents the most attractive application of CCS for Arab NOCs in the near term. EOR – a reservoir management technique for tertiary recovery – has the potential to significantly improve the economics of CCS projects due to the additional oil—and, thus, revenue—it extracts. Although EOR benefits vary substantially according to recovery rates and prevailing oil (or gas) prices, Booz & Company analysis suggests that EOR may completely offset the costs of integrated CCS projects in the most favorable cases.

* Scope 1 emissions are emissions that a company and/or business generates directly while Scope 2 emissions result from the import of goods and/or utilities such as power and water that bear a carbon content.