

Summarized Final Report of the Iraq's Integrated National Energy Strategy

Introduction

This report presents the recommendations achieved by the Integrated National Energy Strategy (INES) for Iraq. It describes the current challenges facing Iraq's energy sector and the opportunities presented by Iraq's energy resources. It defines a vision and a set of national policy objectives for Iraq's energy future. It then lays out a long-term plan of policy commitments, infrastructure development, and institutional reform designed to achieve that vision.

The scope of INES includes all the major components of Iraq's energy sector: upstream and downstream oil, natural gas, power, and linked industries. The recommendations presented reflect the economic interdependency of these components and their collective impact on Iraq's socio-economic and environmental welfare. It covers a time span extending from the present to 2030.

The INES has been developed over the past 18 months by Booz & Company under the guidance of a steering committee of Iraqi government officials established by the PMAC, representing the Ministries of Oil, Electricity, Planning, Finance, Mining and Industry, and Environment. This steering committee has held more than 40 workshops to review data and recommendations, and has played the lead role in setting the direction of the report, identifying areas for analysis, reviewing and modifying data and assumptions, and making policy choices.

The information used in developing the INES was gathered through extensive interaction with Iraqi government ministries. This interaction involved an iterative process of collecting, reconciling, and updating historical and current data. These data sources have been supplemented by more than 150 interviews with government officials in the Iraq federal government, with officials in Iraqi State-Owned Enterprises, with executives of international oil companies and oil service companies involved in Iraq, and with numerous technical consultants engaged in Iraq's development plans. Although nearly all the official data made available pertains to activities managed by the federal Government of Iraq, interviews conducted with several senior officials of the Iraq Federal Region of Kurdistan provided insight into that region's policies and plans as well.

The study has been conducted in five phases.

Phase 1 consisted of planning: developing a detailed project plan, detailing data requirements, identifying interview subjects, scheduling interviews, and agreeing on mechanisms for information collection, verification, and management.

Phase 2 consisted of base-lining: developing a comprehensive understanding of the current conditions of each subsector within the energy sector, identifying the principal challenges and strategic choices facing each subsector, and framing those challenges in the context of Iraq's socio-economic and environmental circumstances.

Phase 3 consisted of formulating the strategy: defining a vision and strategic evaluation framework, identifying broad strategic choices, and selecting an overall strategic design.

Phase 4 consisted of detailing the strategy: developing integrated infrastructure priorities, specifying the scope, timing, and sequence of investments, allocating resources to uses, and identifying the institutional reforms needed to effect these plans.

Phase 5 consisted of finalizing the report: preparing final documentation, reviewing conclusions with the PMAC and with Iraq Ministries, and clarifying recommendations.

Iraq is endowed with one of the world's richest supplies of oil and gas. Properly developed, this endowment can be the foundation of a diverse, productive, and continually growing economy. In order to realize this potential, Iraq needs strategic clarity in two areas. The first area is economic, involving resource allocation and capital investments. The second is institutional, involving accountabilities, capabilities, governance, and industry structure.

Because multiple institutions must work together to accomplish the purposes of an integrated energy strategy, a clear economic roadmap is needed that sets a shared agenda. Because that agenda can be accomplished only through effective management of a large number of complex, interconnected tasks, strong institutional roles and capabilities also are needed. The INES recognizes this dual need for economic and institutional direction, and provides recommendations in both areas.

Chapters of the Final Report explain the following:

Chapter 1 presents an introduction to the Integrated National Energy Strategy Final Report. **Chapter 2** provides a description of Iraq's energy sector baseline. It summarizes Iraq's current energy position and existing development plans, and describes the challenges faced by the sector.

Chapter 3 considers the socio-economic context in which the energy sector operates, and the particular stresses that the energy sector imposes on the environment

Chapter 4 describes the framework used to define the strategy: beginning with a vision statement, proceeding to strategic objectives, and analyzing the strategic building blocks of supply, demand, and resource allocation priorities.

Chapter 5 describes and explains the INES economic plan. It evaluates that plan against the defined INES policy objectives, and assesses its risks and sensitivities.

Chapter 6 turns to the institutional dimension of INES, describing at a strategic level the legal and institutional initiatives needed to implement effectively the plan described in Chapter 5.

Chapter 7 lays out a timeline of steps required by INES, defines the key metrics by

which progress should be assessed, and recommends a structure for providing on-going INES oversight, execution, and coordination.

The INES is designed to provide a common strategic agenda for the various entities involved in directing and managing Iraq's energy sector. Major planning efforts are still required to develop the technical, budgetary, and organizational details of this strategy. Decisions regarding site locations, infrastructure configuration, environmental remediation, and many other issues need to be made on the basis of detailed technical analysis. INES provides a framework for these further studies and decisions, and specifies many of the subjects they need to address, but it is not a substitute for them.

The current narrative document summarizes INES findings, analyses, and recommendations. The appendices to this document provide further supporting detail. The narrative and appendices together constitute the final INES report.

Summary of the Final Report

This report recommends an Integrated National Energy Strategy (INES) for Iraq. It defines a vision for Iraq's energy future, assesses the energy resources available to Iraq, and considers options for deploying those resources. On that basis it proposes a long-term plan of investment, infrastructure development, and institutional reform.

The report covers a time span extending to the year 2030. It includes all the major components of Iraq's energy sector: upstream and downstream oil, natural gas, power, and linked industries. It takes an integrated perspective toward these subsectors, analyzing their interactions with each other and assessing strategic alternatives in terms of their impact on the sector as a whole rather than on any single subsector. Additionally, the report considers not only the energy sector's internal economic dynamics but also its broader socio-economic and environmental context.

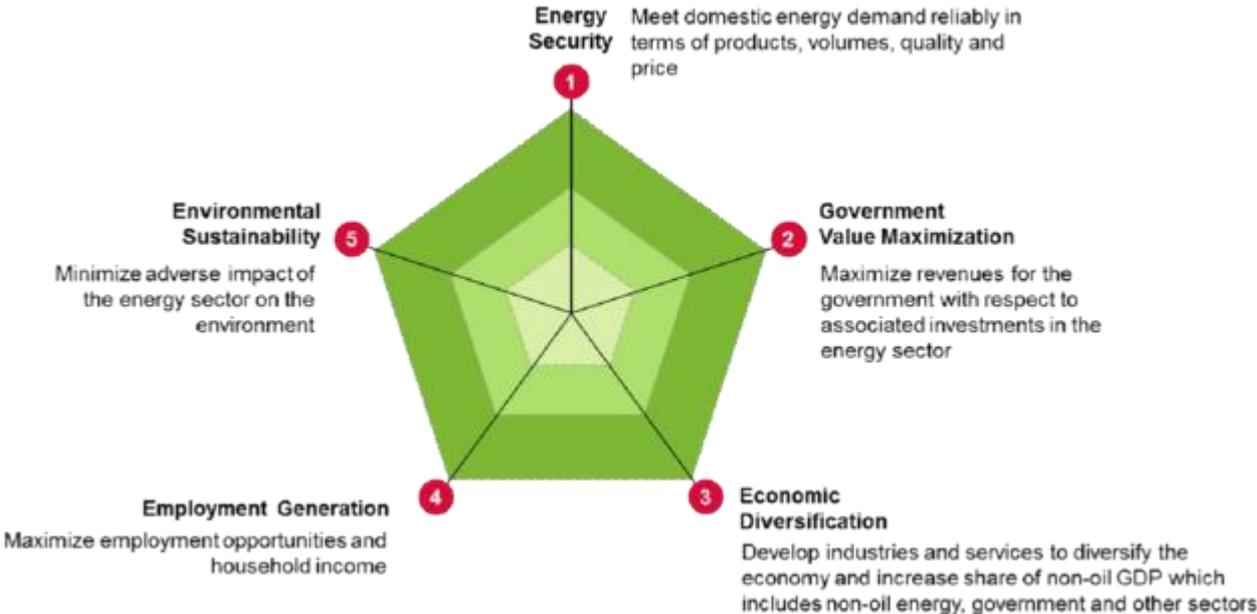
Iraq's overall economy is closely linked to the performance of its energy sector. Both have suffered from forty years of intermittent warfare and international sanctions. Iraq today has oil and gas reserves that rank among the world's largest, yet the infrastructure needed to take advantage of these resources is in disrepair, industries that depend on these resources are virtually non-existent, and Iraq's electric power system is chronically unable to meet demand.

The aim of the INES is to define a plan that will reverse this deterioration and develop Iraq's energy resources to their full potential. This aim is reflected in the INES vision statement.

“Develop the Energy sector in a coherent, sustainable and environment-friendly manner to meet domestic energy needs, foster the growth of a diversified national economy, improve the standard of living of Iraqi citizens, create employment, and position Iraq as a major player in regional and global energy markets”

From this vision statement, five dimensions of evaluation have been defined which shape the strategic choices of INES.

Exhibit ES - 1: INES Strategy Evaluation Dimensions



The program of investments and reforms set forth in INES provides major gains on all these dimensions and lays a foundation for future national prosperity. Accomplishing this program, however, will require purposeful and coordinated government action and institutional commitment.

In particular:

- INES requires immediate infrastructure development across all energy subsectors: oil (upstream and downstream), gas, power, and industry. Development must be rapid, but also balanced. These subsectors are interdependent. Each depends for its own advancement on advances in the others. They need to evolve in parallel.
- The delivery of INES benefits cannot begin until the basic infrastructure for all of these subsectors is in place. The next three years of infrastructure development are critical to the success of INES. Once effective linkages have been established among the various energy subsectors, enormous benefits will begin flowing to the people of Iraq. On the other hand, breakdowns in those linkages will create supply bottlenecks that waste time, resources, and opportunity.
- In order to accomplish the ambitious short-term INES infrastructure program, Iraq’s energy-sector Ministries will need to focus intensely on specific critical tasks. These tasks are enumerated in the INES.

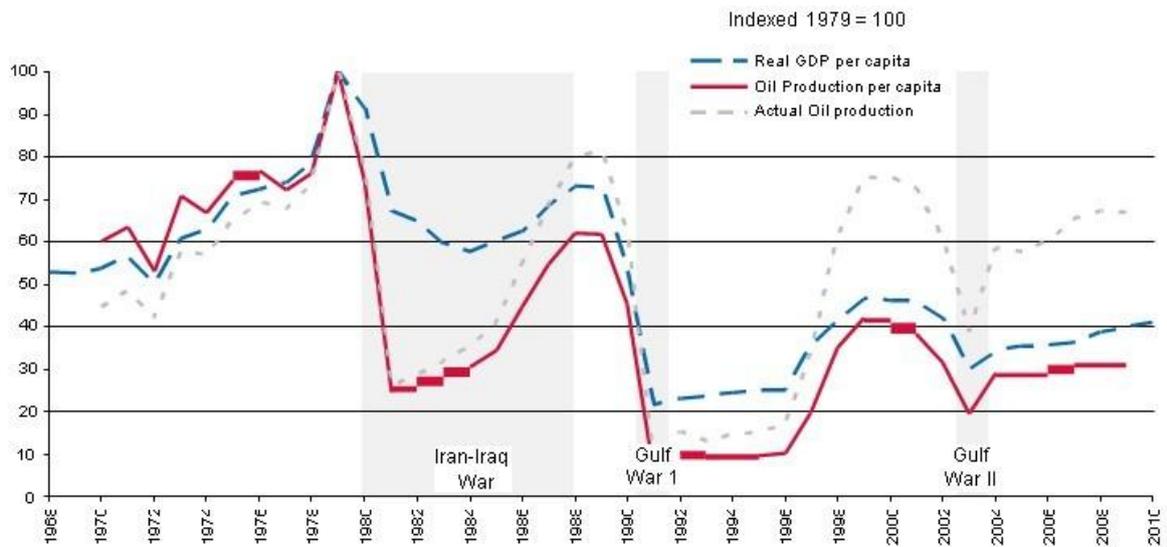
- Rapid, sustained, and balanced growth in the medium- and long-term phases of INES will require fundamental institutional reforms. Energy-sector Ministries will need to reorganize. They also will need to establish regulations, programs, and institutions that encourage private-sector participation in the energy sector. International investment needs to be encouraged in order to introduce world-class standards of technology, performance, and transparency. Local private investment needs to be encouraged in order to build domestic skills and entrepreneurship and to diversify economic development.
- Along with managing large and immediate growth in infrastructure, Iraq's Ministries also will need to foster rapid growth in institutional capabilities. In particular, they will need to employ a variety of tools to stem and to reverse the flight of talent from Iraq, and to build professional capabilities in such areas as accounting, engineering, planning, contracting, law, and general management.
- Implementation of INES will require a strong INES governance mechanism that sets benchmarks, monitors progress, addresses obstacles, adapts plans to new circumstances, and ensures continual coordination among Ministries. Such a response system of governance and coordination will mitigate the downside risk of not achieving the full benefits of INES by minimizing slippages and under-performance.

Iraq is endowed with great resource wealth. Its challenge is to unlock that wealth through a coordinated plan of development, managed through capable institutions. INES sets forth a strategy for meeting that challenge.

The Upstream Oil Subsector

Iraq's economy is closely linked to oil production. Forty five percent of Iraq's GDP and ninety percent of the federal government's revenue in 2010 came from oil exports. Iraq's prosperity depends on a sustained revival of oil production and prudent use of the wealth it creates.

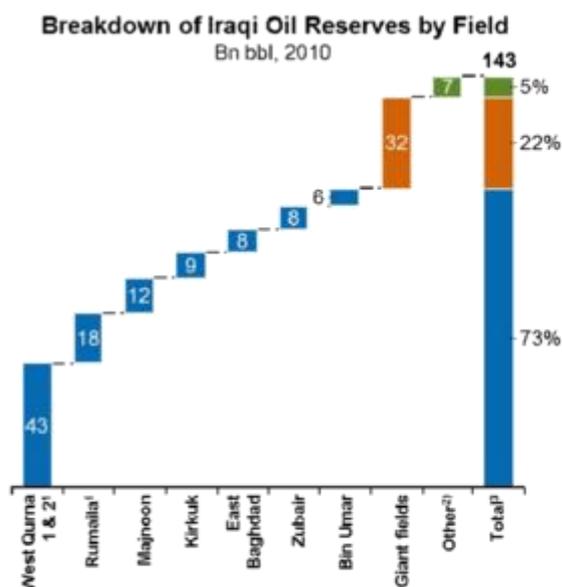
Exhibit ES - 2: Linkage between Iraqi Oil Production and Prosperity



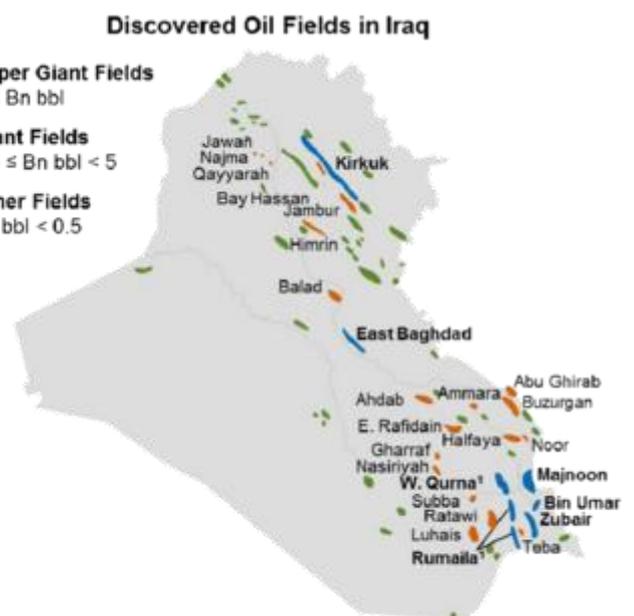
Source: UN, CSO, Booz & Company analysis

Iraq estimates that it has 143 billion barrels of conventional oil reserves, the third largest national reserve of conventional oil in the world after Saudi Arabia and Iran. Three-quarters of these reserves are concentrated in seven super-giant fields: West Qurna, Rumaila, Majnoon, Kirkuk, East Baghdad, Zubair, and Bin Umar. All of these fields except Kirkuk and East Baghdad are located in the country's southern region. Iraq's oil resources have not yet been fully explored, and they may turn out to be much higher than current estimates, possibly in excess of 200 billion barrels.

Exhibit ES - 3: Iraq's Oil Reserves

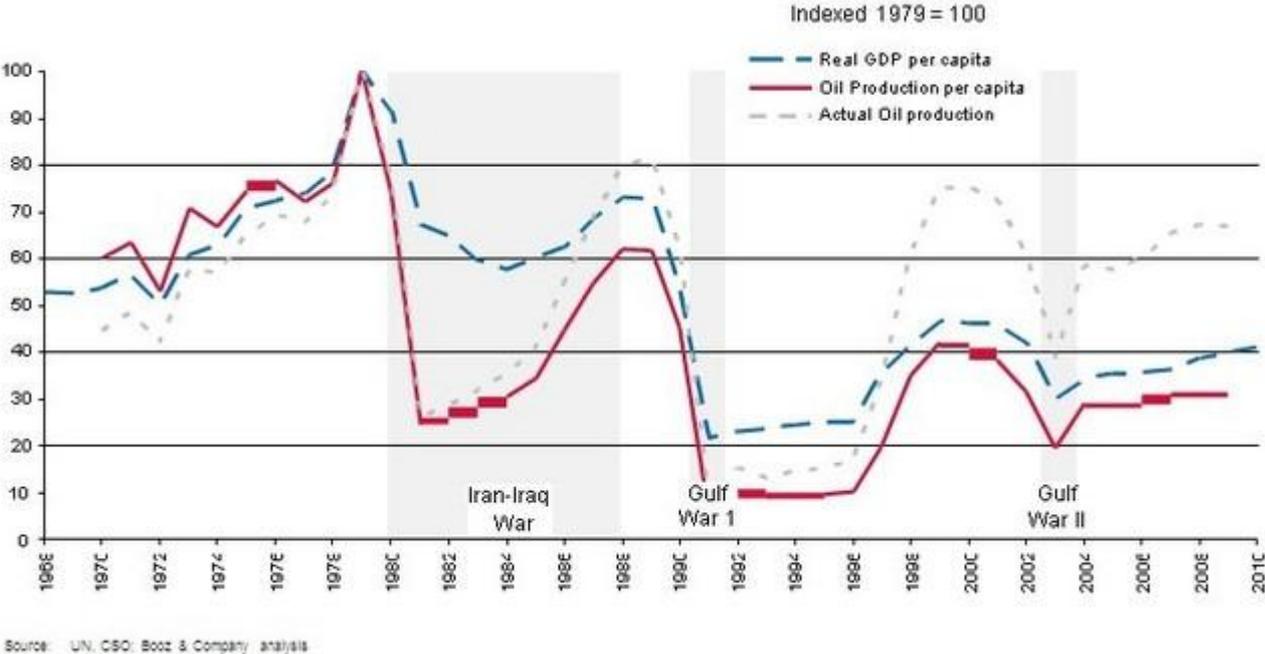


1) W. Qurna includes both W. Qurna 1 and 2, Rumaila includes both Rumaila North and South
 2) 'Other' comprises 51 small fields
 3) Excludes IFRK
 Source: Iraq Ministry of Oil, Energy Compass (October 2010); Booz & Company analysis



In the past three years Iraq has taken major steps to increase future production. Most importantly, the federal government has awarded technical service contracts (TSC's) to several major international oil companies in order to develop or increase production from twelve large oil fields. Projections of future production from these fields are necessarily uncertain, and a range of production profiles therefore has been considered for planning purposes.

Exhibit ES - 4: Alternative Oil Production Profiles



Iraq's primary upstream strategic objective now is to ensure that the development of these fields proceeds expeditiously, aiming for production by the end of 2014 at a rate between the medium and high production profiles. The minimum target production level should be 4.5 mmbpd in 2014. To accomplish this objective, the Ministry of Oil (MoO) will need to pursue three initiatives:

- Monitor and facilitate the execution of upstream development, particularly in the five critical fields (West Qurna 1 & 2, Rumaila, Zubair, and Majnoon) constituting 75% of incremental production.
- Fast-track the Common Seawater Supply Facility (CSSF) project. Possibly expand that project or define alternative schemes to cover additional fields. Ensure that produced water from wells is appropriately treated and made available for reinjection.
- Ensure that field evacuation infrastructure from wellheads to the trunk pipelines is built on time and conforms to Iraq's crude segregation strategy

Iraq's secondary upstream objective is to develop within the next three years a basis for setting long-term production targets. It is recommended that the MoO develop for this purpose a Petroleum Reserve Management System to organize and analyze the information gathered from current oil-field activities, in particular the Final Field Reports and Enhanced Recovery Reports that will be submitted by TSC operators in 2013. Using this system the Ministry will be able to set production levels that optimize the interplay of reservoir conditions, field-management best practices, long-term production potential, project economics, and world market dynamics. Until the time, likely in 2015, when those revised production levels are defined, INES plans are based on the assumption that production will occur at the level of the Medium production profile.

Thereafter Iraq's primary upstream objective will be to manage production and develop reserves in accordance with its long-term production targets.

The Downstream Oil Subsector

The downstream oil sector comprises three broad activities: commercializing crude oil as an export product, refining crude oil into oil products suitable for domestic use and export, and distributing refined oil products to domestic customers.

Crude oil commercialization. Iraq's export capacity until recently has been limited to 2 mmbpd through port facilities in Basra, and 0.7 mmbpd through a pipeline across Turkey to the Mediterranean. The interior North-South Strategic Pipeline connecting the northern and southern evacuation systems is currently inoperable due to war damage. Consequently Iraq today has no flexibility to divert production from one export point to another.

In order to export the projected increases in volumes of oil produced, Iraq will need to expand its evacuation infrastructure. In order to avoid compromising its existing recognized brands of light crude oil ("Kirkuk" and "Basra Light"), Iraq also will need to segregate the heavier grades of crude oil that will be tapped as production increases.

Under the INES plan several initiatives are recommended in the next several years:

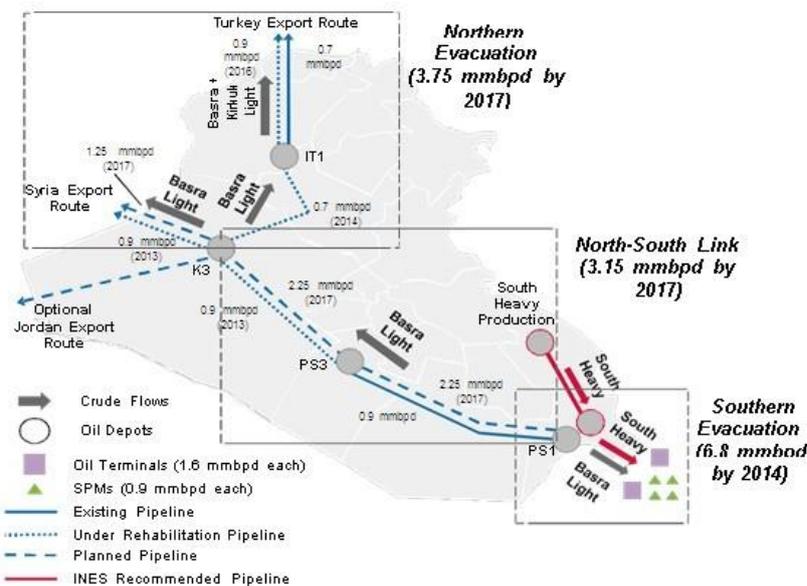
- *The northern evacuation system* will expand to 3.75 mmbpd by 2017. Options to route crude to the Mediterranean via pipelines through Turkey and Syria, and to the Red Sea via Jordan will be considered. The Turkey pipeline itself will be rehabilitated and expanded to a capacity of 1.6 mmbpd. An existing but inoperative pipeline through Syria will be rehabilitated to carry 0.9 mmbpd, and a new parallel pipeline through Syria will be constructed to carry 1.25 mmbpd. A pipeline via Jordan to Aqaba in the Red Sea should also be considered in parallel to provide additional route diversification especially if the Syria pipeline does not materialize. Within the northern evacuation system an existing line between oil depots K3 and IT1 will be rehabilitated to a capacity of 0.7 mmbpd to provide flexibility in directing volumes to the Mediterranean either through Syria or Turkey.
- *The southern evacuation system* will be expanded to an overall capacity of 6.8 mmbpd by 2014. This expansion will comprise the addition of four Single Point Mooring buoys (SPM's) off shore, each with a capacity of 0.9 mmbpd, and an increase in capacity at the Khor Al Amaya Oil Terminal (KAAOT) from its current capacity of 0.4 mmbpd to possibly 1.6. The Al Basra Oil Terminal

(ABOT) will remain at its current capacity of 1.6. In addition to this expansion in terminal capacity, an additional pipeline system from the southern fields to the terminals will be built. 2.0 mmbpd of the evacuation pipeline and terminal capacity will be dedicated to a separate new grade of heavy crude oil. Execution of these plans is currently underway. Recently two of the four planned SPM's and their pipeline linkages were commissioned, and a third is currently being installed.

- *The North-South link* will play a critical role in moving Basra Light to northern evacuation points, and in providing overall system flexibility. The portion of the existing North-South Strategic Pipeline between PS3 and K3, which is currently damaged, will be rehabilitated, so that the entire link between PS1 and K3 will be capable of carrying 0.9 mmbpd by 2015. Additionally a new parallel line will be built from PS1 to K3 to carry 2.25 mmbpd by 2017. The entire capacity of the North-South link by then will be 3.15 mmbpd.

The rehabilitation of the North-South pipeline link and the expansion of export capacity at both ends will give Iraq new possibilities for choosing export routes and markets. Asian market is expected to have largest growth in demand and offer Iraq with the highest netback when routing its crude from its southern terminals through the Arabian Gulf. Recognizing this, INES however proposes that Iraq avoid over-reliance on any single regional market or any single route. INES therefore recommends an evacuation system that provides Iraq the capacity to place a larger proportion of its crude to Asian markets, while offering the flexibility to route up to half its production through its northern boundaries to the Mediterranean and the Red Sea as a hedge against Strait of Hormuz. In addition to flexibility, the route through Iraq's northern boundaries to the Mediterranean also provides the most economic transport to serve western markets. This would therefore require the transport of large volumes of Basra Light from the South to the North.

Exhibit ES - 5: Crude Oil Evacuation Infrastructure



Oil refining. Approximately 20 percent of Iraq's current crude production is refined into products for domestic consumption. Iraq today has major refineries in three locations - Beiji, Daura, and Basra - each supported by a cluster of satellite topping units. The aggregate design capacity of these refineries is 900 kbpd, but due to extensive disrepair the aggregate available capacity is only 660 kbpd.

Even at this reduced level of available capacity, Iraq's total refinery output is more than the country's aggregate domestic demand of 412 kbpd, but the components of demand and production are not aligned. Iraqi refineries produce far more fuel oil than Iraq can currently transport or consume, and the excess is simply blended back into crude oil. On the other hand, these refineries produce less gasoline, gasoil, and LPG than is needed domestically. This undersupply of gasoline, gasoil, and LPG creates a substantial import requirement, with a net annual cost to Iraq in 2009 of approximately \$250 million. Moreover, the gasoline that Iraq's refineries do produce is of poor quality, characterized by high sulfur content, lead additives, and low octane ratings.

As domestic demand for refined products grows, Iraq will need to increase both the capacity of its refineries and the complexity of their configuration. Under the INES plan, over the next three years the existing refineries at Daura and Basra will be upgraded, and selected small topping units will be rehabilitated. Between 2015 and 2019 some existing refining capacity will be retired and new refineries in Qayyarah, Karbala, Amara, Kirkuk and Nassiriyah will be built. This program will increase domestic refinery capacity from 800 kbpd to more than 1,400 kbpd, and will permit Iraq to cover domestic demand in all oil products, at appropriate quality standards, by 2019. Additional capacity will be required in later years as domestic demand continues to grow.

In the future, Iraq should consider adding an export-oriented refinery to add value to its crude oil and to diversify its energy-related export offerings. Any such refinery should handle at least 300 kbpd in order to benefit from scale economies, and it should have a complex configuration capable of processing heavy crude and yielding higher middle distillates in line with international demand. The advisability of adding this capacity will depend on future global market dynamics and refinery margins.

Distribution.

The existing system for domestic distribution of Iraq's refined oil products present challenges in transportation, storage, metering, and retail service.

Over the next three years the MoO should develop a comprehensive plan for reforming this sector. The pipeline network for white products needs to be expanded to reach demand centers and depots across the country. The fuel oil pipeline network and road tanker fleet need to be expanded to convey currently stranded volumes of fuel oil to power plants, cement plants and brick plants. Gasoline and gasoil storage needs to be expanded to align with international standards and located so as to provide balanced geographic coverage. The installation of meters at injection and withdrawal points across the distribution system need to be completed to provide accurate information on volume flows, and control stations need to be established to monitor and manage these flows.

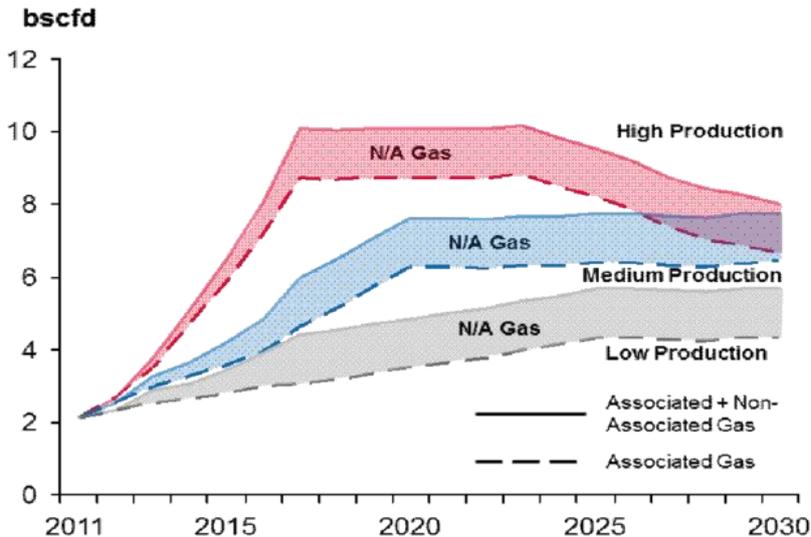
The quality and availability of gasoline retail stations could be dramatically improved by building more stations in high-demand areas, increasing retail margins to incentivize investments in service quality, and establishing and enforcing a code of operating and safety standards. Gasoline retail should be opened to entry by international retailers, and existing OPDC stations should be divested to the private sector.

The Natural Gas Subsector

Iraq estimates that it holds approximately 112 trillion standard cubic feet (Tscf) of natural gas reserves, an endowment that would make it the twelfth largest holder of conventional gas reserves in the world. Broad areas of Iraq especially in the western desert remain unexplored for natural gas, and many existing non-associated gas fields have yet to be fully explored at deep levels. With this additional potential, Iraq’s total gas reserves could be as high as 280 Tscf, placing Iraq among the world’s top five holders of conventional gas reserves.

Iraq produced 1.7 bscfd of gas in 2009, a figure that is low in light of the size of its reserves. In the coming years that production rate will increase substantially. Because production levels for associated gas will track production levels of oil, the three production profiles described above for future oil production yield three corresponding profiles for future associated gas production. Production of non-associated gas is expected to develop at a rate that will not be affected by the different oil production scenarios.

Exhibit ES - 6: Alternative Gas Production Profiles



Notes : Gas production includes Rounds 1, 2 and 3, self operated fields, and KRG fields
 Figures correspond to raw gas produced in fields
 Non-associated gas production is assumed to be the same in the high, medium and low production scenarios
 Source: MoO data, Booz & Company analysis

Increased gas production will present a challenge. Even today at far lower levels of production, more than 40 percent of the gas produced is flared in-field, a practice that not only wastes a valuable and needed resource but also creates significant air

pollution and carbon release. This flaring occurs because most Iraqi oil fields lack the infrastructure needed to gather and process gas, and because the pipeline system needed to transport gas from processing plants to consumption points is inadequate.

The amount of gas that currently is flared would be sufficient, if properly handled, to meet most of Iraq's currently unmet gas needs. Because of these infrastructure deficiencies, however, Iraq has both an excess of gas at the fields and a deficit of gas at consumption points.

This shortage of delivered gas imposes significant economic costs. It forces power plants to use more expensive and less efficient fuel substitutes like crude oil and fuel oil. It precludes altogether the introduction of efficient combined-cycle power plants. It also precludes development of industries such as fertilizers, petrochemicals, steel, and aluminum that depend on gas feedstock and gas fuel.

Consequently, Iraq's primary objective in the natural gas subsector is to develop the infrastructure needed to handle and distribute gas production. Plans are in place to accomplish this objective. Under the terms of Iraq's Technical Service Contracts with international oil companies, a large number of oil field operators are responsible for developing and operating gas gathering and processing facilities for the gas they produce. The MoO is responsible for gathering and processing at its self-operated fields. In addition, the MoO will need to develop a pipeline system to convey processed gas to consumption points. This infrastructure development is scheduled to occur between now and the end of 2014, at which point adequate physical linkages will connect gas production and gas consumption, and flaring can be minimized.

Between now and the end of 2014, MoO needs to pursue three initiatives:

- Monitor and expedite the development of field-level gathering, compression, and processing facilities.
- Install the infrastructure needed to connect processing facilities with demand locations.

In addition to dry gas, Iraq's processing plants will also produce Liquid Petroleum Gas (LPG) and light naphtha. The existing infrastructure connecting gas processing plants and refineries to LPG end-users will need to be expanded, and bottling capacity close to domestic demand centers will need to increase. Both LPG and light naphtha will be produced in quantities greater than needed to serve domestic demand. In order to export this surplus, appropriate storage facilities and terminal facilities will need to be developed in the South.

- Commission a technical plan for a Master Gas System. As power plants and industrial facilities come on line, the variety of stakeholders and handover points will grow.

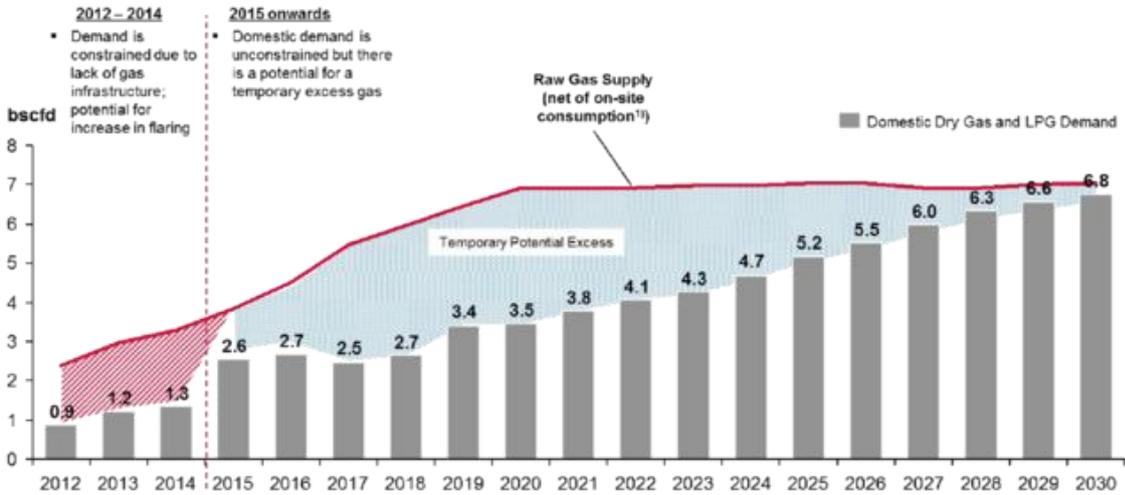
Requirements regarding gas composition, volumes, delivery location, and delivery schedules will require a complex network of pipelines, storage facilities, compression points, and centralized control. A detailed technical study is needed to design an

optimum infrastructure plan, including technical standards and regulations for construction and use of the system.

By 2015, virtually all of Iraq’s gas production should be captured and processed and available for transport to domestic end users. By that point, gas flaring due to inadequate infrastructure would be minimized, and all of Iraq’s domestic gas requirements will be satisfied.

However, beginning in 2015 a different stranded gas challenge may arise. At that point more gas will likely be produced and processed than Iraq can consume domestically. That surplus will need to be exported. If it cannot be exported, it will have to be flared, at volumes exceeding even those experienced today.

Exhibit ES - 7: Potential Export of Surplus Gas



Beyond 2015, once all domestic uses for natural gas have been met for power generation and for the development of gas based linked industries, any potential surplus gas can be exported. Potential export markets are available, but each such market will require the construction of a dedicated pipeline or LNG infrastructure, and each of the pipeline options will require long- term supply commitments. In order to make those long-term commitments, Iraq will need to ensure that its surplus production remains steady. Since production from currently producing fields will eventually level off, and since domestic demand will continue to rise, that surplus can be sustained only if new non-associated gas fields are developed.

The long-term objective for the Natural Gas subsector is therefore to manage the balance of gas supply and off-take. This objective involves two initiatives:

- Establish gas export contracts and pipeline connections with regional customers that are sufficient to absorb excess gas production in the medium term, and that are sustainable in the long term through development of new gas reserves.

- Through exploration and development of non-associated gas reserves, assure a long- term supply of gas that is independent of oil production and that can be produced flexibly to meet demand requirements.

The Power Subsector

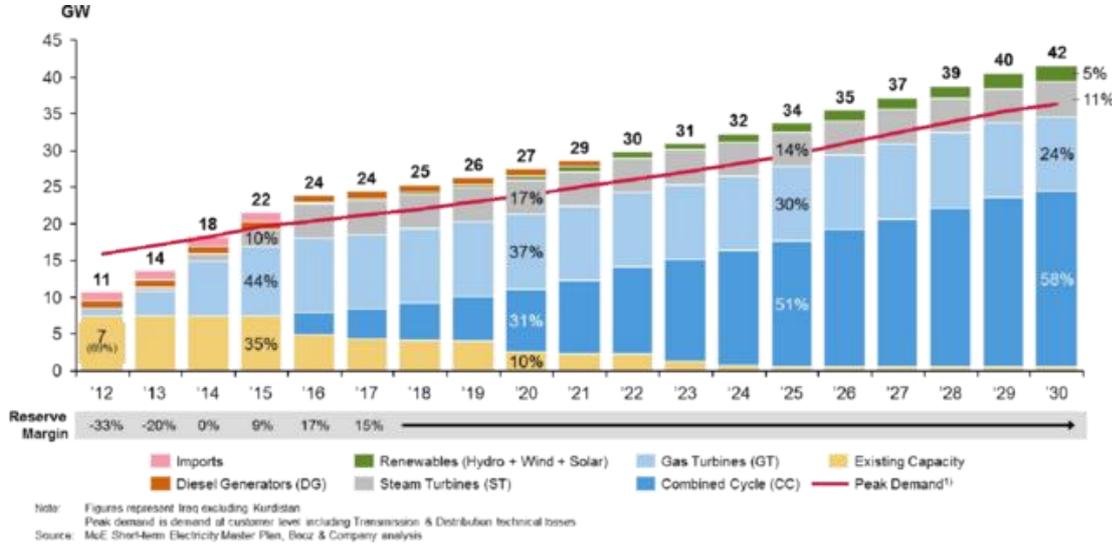
Iraq suffers from a severe shortage of electricity. This shortage imposes major costs on the economy in the form of lost production time, damage to capital assets from power interruption, and an inability to carry on normal commercial processes on a reliable schedule. In a country that experiences cold weather in the winter and extremely hot weather in the summer, the shortage of power also imposes significant hardship on individuals. The absence of reliable power supply from the grid has led to the widespread installation of private diesel generators, whose constant operation imposes high generation costs, creates noise, pollutes the air, and emits large quantities of carbon into the atmosphere. It is estimated that the total cost to the Iraqi economy attributable to power shortages exceeds \$40 billion annually.

While this shortage is due to a variety of system deficiencies, the necessary first step toward addressing it is to increase generation capacity. Under the INES plan, 40 new plants will be built between now and 2016, adding 22 GW of capacity to the 7 GW of effective capacity currently available. These new plants will consist of steam and gas turbines, capable of running on natural gas in the long run but also capable of running on fuel oil when needed. This flexibility in fuel requirements will be important during the next few years, when gas infrastructure will be under development and gas supplies may continue to be restricted.

By 2016 there will be sufficient available capacity in the system (after adjusting for local operating conditions and expected technical losses) to meet peak demand with a reserve margin of 15 percent. Thereafter the fleet will expand to keep pace with demand growth, and newer plants will displace inefficient existing plants. The only fossil fuel capacity to be added after 2016 will be Combined Cycle Gas Turbines (CCGT's), which are the most fuel-efficient and least environmentally damaging of fossil fuel technologies.

Renewable generation will be used in the short term to supply remote off-grid demand locations. In the medium- to long-term, solar and wind power capacity will be developed for connection with the grid, and the potential for hydro-power development will be examined. By 2030 it is expected that renewable capacity will exceed 2 GW, approximately 4-5 percent of total system capacity.

Exhibit ES - 8: Planned Expansion of Iraq’s Generation Capacity



As a consequence of these changes to the generation fleet, Iraq’s fuel consumption for power will shift strongly toward natural gas. Imports will end by 2016. Crude, heavy crude, and LFO all will be phased out as power fuels and redeployed to export, refineries, and industry. Natural gas, which fuels one quarter of power production today, will fuel four-fifths by 2030.

In parallel with these improvements in generation capacity, Iraq will expand, strengthen, and de-bottleneck the T&D network. Technical losses will be reduced to acceptable levels and a smart grid program will be initiated to monitor grid performance and enhance peak load management.

Once a publicly acceptable level of supply reliability is established after 2016, Iraq will begin to increase tariffs, aiming toward a gradual alignment of price with cost. As tariffs begin to reflect the economics of power production, demand-side management measures can be introduced such as green building codes, load control programs, district cooling in high density areas, gas kitchens, and solar water heaters.

As Iraq acquires self-sufficiency in power, it will be able to develop a strategy for international power exchange, either as a net exporter or as part of a cooperative regional grid for reserve sharing and load balancing. Iraq has already entered into power exchange agreements with neighboring countries such as Iran and Turkey. Iraq’s location provides a strategic position for potential wheeling of power from the Middle East to Europe. In a possible future environment where the Middle East’s solar potential is developed to a point where it can provide substantial carbon-free power for export, Iraq could be an important grid cross-road to regional and Western power markets.

The Linked Industries Subsector

Six industries in Iraq fall into the category of linked industries: petrochemicals,

fertilizers, steel, aluminum, cement, and bricks. Each of these industries consumes large quantities of energy in the form of power or heating fuel for its production processes, and two of these industries (petrochemicals and fertilizers) require large quantities of natural gas components as feedstock for their products. Each of these industries provides a foundation for multiple secondary industries and thereby provides a vital link in converting Iraq's energy resources into national economic strength.

Today these six industries are underdeveloped and in various states of disrepair and disuse. Chronic shortages of power and feedstock severely limit their operation. Most of Iraq's domestic demand for the products of these industries is met through imports. Yet each of these industries, if built to sufficient capacity, and if provided sufficient energy resources, has the potential to develop into a significant and profitable producer, meeting all of Iraq's needs and in some cases establishing also a material export presence.

- **Bricks.** At the end of 2012, Iraq will have 29 MTPA of capacity for brick manufacture.

Domestic demand exists currently for 43 MTPA, and is expected to grow with Iraq's reconstruction, rising to 65 MTPA in 2030. Because of high transportation costs, domestically manufactured bricks should be in a position to displace imports. To serve this rising domestic demand entirely from domestic production, INES plans an expansion in brick capacity to 72 MTPA by 2030. Under this plan, domestic demand for bricks will be fully met from domestic production by 2015 and will continue to be met from domestic production thereafter. However, fertile soil currently used as raw material for brick manufacturing should be gradually phased out with the concurrent introduction of alternative materials and new technology.

- **Cement.** Iraq in 2010 had 7 MTPA of utilized cement capacity. This capacity supplies half of Iraq's domestic consumption of 13.5 MTPA; the remaining demand is supplied through imports at an annual cost of \$780 million. Relatively low transport costs and abundant availability of fuel and limestone gives Iraqi cement production an inherent price advantage against imports. INES plans to bring total cement capacity to 65 MTPA by 2030. Under this plan, domestic demand for cement will be fully met from domestic production by 2014 and will continue to be met from domestic production thereafter.
- **Petrochemicals.** Iraq today has limited petrochemical production. Domestic demand of 188 KTPA is met almost entirely through imports at a cost of approximately \$275 million. Yet petrochemicals represent a substantial commercial opportunity for Iraq. Iraq's gas resources are abundant, and they are rich in ethane and other compounds used as feedstock in petrochemical conversion processes. Iraq therefore has a natural advantage in this industry. Similar advantages have led other countries in the Middle East to enter the world petrochemicals market aggressively, growing from a global market share of 8 percent in 2000 to a global market share of 18 percent in 2010. However, many of these countries are encountering constraints in their gas supply, particularly in ethane, and are moving toward use of more expensive, heavier feedstock like naphtha. Over

the coming years, while these countries are adjusting to ethane shortages, Iraq's ethane abundance will give it a highly advantageous position on the global supply curve. Under INES plans, substantial investment will be made in petrochemicals, bringing total capacity to 15.6 MTPA by 2030.

- **Fertilizers.** Iraq in 2010 had three fertilizer plants, with a combined utilized capacity of 300 KTPA. This capacity supplies half of Iraq's domestic demand for fertilizer; the remainder is imported at an annual cost of \$100 million. Like petrochemicals, the fertilizer industry offers a large commercial opportunity for Iraq. Fertilizer production uses methane as its primary feedstock, and Iraq's abundance of natural gas provides a potential cost advantage in world markets. Global demand for fertilizer is expected to grow at an annual rate of 5 percent over the next twenty years as population increases and as pressures for agricultural productivity rise. Even higher rates of demand growth are expected in South Asia, which already today is the world's largest net importing region. South Asia's proximity and accessibility via the Arabian Gulf make the region a promising market for Iraqi fertilizer production. Under INES plans, fertilizer capacity will rise to 6.3 MTPA by 2030.
- **Steel.** Iraq today has no steel capacity and must meet its 2 MTPA of domestic demand entirely through imports at an annual cost of \$1.2 billion. Iraq could profitably displace these imports with its own domestic industry. The locational cost advantage of domestic steel manufacture in domestic markets, combined with relatively low energy cost, will make domestic steel production competitive with imports with respect to long steel products. Iraq's steel advantage in export markets, on the other hand, will be minimal, and the market for Iraqi steel is therefore likely to be limited to domestic customers. Even so, the opportunities for expansion of steel manufacture are significant. Under INES plans, steel capacity in Iraq will reach 10.2 MTPA by 2030.
- **Aluminum.** Iraq currently has no aluminum capacity, but the high energy intensity of aluminum manufacture gives Iraq a natural cost advantage that would likely place it in the most cost-efficient quartile of world aluminum producers. World demand for aluminum is expected to grow over the next decade at an annual rate of 6 to 7 percent as Asian countries continue to industrialize and as global rates of automobile ownership continue to rise. Iraq's potential cost advantage would position it as a strong competitor in this market. Under INES plans, Iraq's aluminum capacity will reach 1.0 MTPA by 2030. Brick and cement manufacture should be developed in diverse locations within Iraq in order to draw on local raw materials and to serve local construction needs. Petrochemicals, fertilizers, steel, and aluminum, on the other hand, require proximity to import and export routes, reliable supplies of gas and power, and modern infrastructure. For these reasons INES recommends the establishment of an industrial park near Basra capable of accommodating the establishment and expansion of not only these primary industries but also the downstream and support industries that will develop around them. In addition, in order to ensure coordinated development of these industries, to develop infrastructure synergies, and to encourage participation of private capital within a predictable and consistent policy framework, INES

recommends the establishment of the Iraq Strategic Industries Company responsible for managing the Iraqi government's investments in these industries and for sponsoring joint ventures with international investors.

INES Investment Requirements and Results

The development program recommended by INES will require capital and operating expenditures of approximately \$620 billion (\$530 billion as capital expenditures and \$90 billion as operating expenses), in 2011 dollars between 2012 and 2030, including all contracted payments to TSC operators. Of this total figure, it is assumed that about 15 percent will be available from private investments, primarily in refineries and linked industries.

Approximately 60 percent of projected INES expenditures by the Government of Iraq will go toward the production and evacuation of crude oil, and much of that amount will consist of reimbursements to the MoO's TSC operators. 15 percent of expenditures will go toward the production and handling of natural gas, and another 15 percent toward the renovation and expansion of the national power system.

Over the period covered by INES, the revenue to the government generated by these expenditures is expected to amount to approximately \$6 trillion. Of this amount, almost 85 percent is attributable to oil exports. The cash flow from these cost and revenue projections is highly positive from the outset. At the base-case benchmark oil price assumption of \$110 per bbl for Brent (in constant 2011 dollars), the net present value of cash flow over the span of INES is \$5 trillion. The NPV rises or falls by roughly \$1 trillion as the assumed average oil price over the INES time period rises or falls by \$20.

This investment program also provides positive results with respect to the other four INES dimensions of strategy evaluation. All domestic demand for energy and energy-intensive products will be met through domestic production by 2022. Employment in the general economy, spurred by governmental reinvestment of energy sector revenue, is expected to rise by 10 million jobs by 2030, bringing Iraq to a condition of full employment. By 2020, economic activity in the non-oil-and-gas sectors of the economy will be growing at a pace that surpasses growth in the oil and gas sector. Thereafter, the economy's relative dependence on oil will steadily diminish.

By displacing inefficient power plants, by improving the quality of transportation fuels, by eliminating gas flaring, and by establishing a comprehensive water-resource infrastructure

for use in oil production, the INES investments will address directly some of the most glaring environmental challenges currently facing Iraq. The economic growth engendered by these investments will need to be accompanied by a comprehensive national commitment to environmental protection.

While specific economic projections are of course sensitive to oil price and production assumptions, the basic INES recommendations for infrastructure investment, timing, and capacity development appear to be valid under a broad range of economic assumptions.

In this sense, INES is a low-risk strategy.

However, successful execution of INES is subject to numerous risks. INES calls for infrastructure build-up at a pace well beyond anything that Iraq has managed before now. Iraq must overcome logistics bottlenecks, resource constraints, and institutional limitations to coordinate and manage multiple major initiatives. Iraq also must design and plan a long-term structure for sector governance capable of achieving the long-term INES vision. These challenges highlight the importance of institutional alignment with the INES plan.

Institutional Reform

The energy sector's institutional challenges fall into two time-frames, short-term and middle- to long-term.

Short term. In the short term the paramount challenges concern implementation. The INES plan is front-loaded, in the sense that numerous significant infrastructure and design decisions need to be made and implemented within the next three years, all in coordination with one another. The sector's rate of investment spending will double during this period. Large numbers of contracts will need to be awarded and managed, and a greatly expanded capital plant will need to be built and operated.

Three ministries will have primary responsibility for these tasks: the Ministry of Oil, the Ministry of Electricity, and the Ministry of Industry and Minerals. INES proposes that each of these Ministries establish a task force empowered to coordinate and expedite the INES agenda within its Ministry. Because of the need for simultaneous development of oil and gas infrastructure, it is proposed that the Ministry of Oil establish two such task forces, one for oil and one for gas.

It is proposed also that each Ministry also establish an institutional reforms committee in addition to its task forces. This committee would be assigned to oversee the improvement of long-term institutional capabilities and the design of a long-term institutional structure.

The task forces and the institutional reforms committees should be chaired by a Minister or Deputy Minister. Each task force and committee should comprise 6 to 7 senior officials of its Ministry, supported by external advisors as needed. Each should have the authority to make decisions on behalf of its Ministry, and each should be held accountable for accomplishing a specific set of tasks pursuant to the INES schedule.

The MoO's Oil Task Force will be responsible for ensuring that oil production ramps up on schedule. It will monitor and expedite field works, facilitate logistics, and oversee development of the water injection infrastructure and oil evacuation infrastructure. The Gas Task Force will monitor the development of needed gas gathering, processing, and transport infrastructure, and ensure alignment with user requirements. It will commission the design of a Master Gas System that optimizes pipeline architecture, provides efficient systems of flow control, and defines appropriate technical standards and regulations for the gas system.

The MoO's Institutional Reforms Committee will be responsible for developing and

overseeing a long-term agenda for building institutional capabilities and reforming institutional structures. In the short term it will establish a Petroleum Reserve Management System to help organize and analyze oil field data and support the development of long-term production targets. It also will review and revise current programs to incentivize private investment in refineries, and will recommend policies for the domestic pricing of oil products, to be implemented within the next year in order to permit industrial planning.

The MoE's Power Task Force will be responsible for ensuring that the Ministry's short-term plan for expanding and commissioning new generation capacity is accomplished on time. It will confirm that the necessary EPC contracts and fuel allocations are in place, that plant construction proceeds on schedule, that transmission is upgraded to handle new production, and that plans are in place for operating the new plants once they are commissioned. The MoE's Institutional Reforms Committee will develop a long-term agenda for capabilities improvement and institutional restructuring. It also will initiate a program for the phased introduction of Independent Power Projects (IPPs) into the Ministry's generation portfolio.

Finally, the MoE will establish a Loss Reduction Committee charged with developing a program for reducing technical and commercial losses and defining a potential role for private- sector operators of distribution systems.

The MoIM's Linked Industries Task Force will have two short-term responsibilities. The first is to establish a government-owned Iraq Strategic Industries Company to coordinate and sponsor joint ventures in petrochemicals, fertilizers, steel, and aluminum. The second is to establish an Industrial Park Authority with the authority and resources to develop a major industrial park near Basra to provide shared infrastructure and facilities support to strategic export industries. The Ministry's Institutional Reforms Committee will be responsible for developing long-term plans for capabilities improvement, Ministry restructuring, and promotion of local content in industry.

Medium to Long term. In the medium to long term, Iraq's energy sector needs to adopt institutional reforms that will equip it to oversee lasting growth and value creation. Because hydrocarbon resources and their energy derivatives will dominate Iraq's economy for the foreseeable future, Iraq's future prosperity will depend to a large degree on the professionalism, transparency, efficiency, and integrity of its energy sector management. A framework of energy governance is needed that insulates the sector from short-term political pressure and allows sector managers to focus on the economic performance of their businesses.

The Industry Reforms Committees within each Ministry will be responsible for four issues that are central to establishing this kind of institutional environment. During the short term, these committees will develop plans addressing these issues; in the medium term the Ministries will implement those plans.

- *Capability development.* Each Ministry needs to expand and strengthen its base of professional skills. Skills are particularly needed in the areas of contracting, project management, operations and maintenance, planning, regulation, and

environmental management. Each Ministry needs an aggressive program to recruit, hire, and train skilled personnel. It also should work with national universities to develop programs of classroom and on-the-job technical and managerial training. In addition, each Ministry should work with its international contractors to incorporate training opportunities for Iraqis into their construction and management services.

- *Institutional design.* Governance of the energy sector should be characterized by (1) clear separation and accountability for the policy, regulatory, and operational aspects of governance; (2) unambiguous distribution of responsibility between federal and regional authority; (3) corporatized structures for the entities responsible for operations, and (4) unbundling of operational responsibilities to the extent needed for transparency, economic coherence, and competitive readiness. INES provides institutional design recommendations in these areas for each Ministry, for consideration by that Ministry's Institutional Reform Committee.
- *Private sector involvement.* Participation by international investors provides not only a source of capital to the energy sector but also a source of investment discipline. International investors in Iraq would introduce international standards of financial accountability and transparency, serve as a reality check on the economic viability of investments, and provide a path for the introduction of world-class technology and expertise. Each Ministry should explore opportunities for expanding private-sector participation opportunities and attracting private sector investment. It also should establish programs to encourage and develop local private-sector content in its sphere of operation in order to expand and diversify Iraq's private economy.
- *Pricing.* Many of Iraq's energy products, most notably power, are priced at levels that have little relationship to their cost of production or their opportunity cost. Over the long run this misalignment leads to resource inefficiency, creates barriers to competition, and makes it difficult to establish a workable market environment. Over the course of INES, indirect subsidization of energy pricing through non-economic pricing should be gradually phased out.

INES Governance

INES establishes a highly ambitious set of objectives, many of which are scheduled for achievement in the initial, short-term phase. The expansion of oil production, the installation of gas infrastructure, and the elimination of power shortages cannot be delayed without great cost to the economy, the environment, and to the well-being of the Iraqi people.

Once these short-term objectives are accomplished, a strong foundation will be laid for long-term development. The energy sector at that point will have momentum for accomplishing the significant objectives that lie beyond 2015.

The short term is the point of critical risk. Objectives are front-loaded into this period, but institutions have little running room to build the capabilities needed.

In addition to the special Ministerial task forces recommended, INES requires an oversight framework at the highest levels of government to ensure that the right economic and managerial resources are applied to these immediate needs, and that appropriate coordination occurs among Ministries.

INES should be owned by the Executive Branch of the Government through the Prime Minister's office that will approve strategic decisions and allocate budgets. The Legislative Branch represented by the Council of Representatives and its dedicated committees will monitor the implementation of INES and support the Government in its responsibilities.

INES recommends that Iraq establish an INES Steering Committee responsible for the Implementation of INES. The Steering Committee will be chaired by the Deputy Prime Minister for Energy Affairs or the Chairman of the PMAC. It will comprise senior representatives such as deputy ministers from the Ministries of Oil, Electricity, Industry and Minerals, Environment, Planning, and Finance. The responsibility of the Steering Committee will be to keep INES implementation on track and to provide a forum where high-level decisions can be reached quickly.

Supporting the Steering Committee will be a Program Management Office (PMO) that will monitor progress, provide regular reports, and identify issues for resolution. It also will provide a day-to-day point of coordination among the Ministerial task forces and committees to ensure that plans are aligned and synchronized, and that necessary collaborations between Ministries are occurring.