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Tapping a Hidden Resource

Energy Efficiency in the Middle East and North Africa

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Sustainable Development Unit
Middle East and North Africa Region
Energy Sector Management Assistance Program (ESMAP)

ESMAP
Energy Sector Management Assistance Programme

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Energy Sector Management Assistance Program

Acronyms and Abbreviations

AD	Algerian Dinar
ASEAN	Association of Southeast Asian Nations
bcm	billion cubic meters
Btu	British thermal unit
CCGT	combined cycle gas turbine
CFL	compact fluorescent lamp
CGE	computable general equilibrium
c.i.f	cost, insurance and freight
CNG	compressed natural gas
CO_2	carbon dioxide
COELBA	Companhia de Electricidade do Estado da Bahia
CTF	Clean Technology Fund
DALY	disability-adjusted life year
DSM	demand-side management
EAP	East Asia and Pacific
EC	European Commission
ECA	Europe and Central Asia
EdL	Electricité du Liban
EE	energy efficiency
EMC	energy management company
ESCWA	Economic and Social Commission for Western Asia
EU	European Union
GCC	Gulf Cooperation Council
GDP	gross domestic product
GEF	Global Environmental Facility
GGFR	Global Gas Flaring Reduction
GHG	greenhouse gas
GMAPS	Global Model of Ambient Particulates
GNI	gross national income
GST	general sales tax
GTAP	Global Trade Analysis Project
GW	Gigawatt
GWh	Gigawatt-hour
IEA	International Energy Agency
IGCC	integrated gasification combined cycle
EIA	Energy Information Administration
ESCO	energy services company
ESMAP	Energy Sector Management Assistance Program
HFO	heavy fuel oil
IAP	indoor air pollution
IFC	International Finance Corporation
IMF	International Monetary Fund
JD	Jordanian dinar

kgoe	kilogram of oil equivalent
ktoe	thousand tonnes of oil equivalent
kWh	kilowatt-hour
LAC	Latin America and Caribbean
LE	Egyptian pounds
LNG	liquefied natural gas
LPG	liquefied petroleum gas
MCREE	Mediterranean Centre for Renewable Energy and Energy Efficiency
ME	Middle East
MED-ENEC	Mediterranean Project for Energy Efficiency in the Construction Sector
MENA	Middle East and North Africa region
MIGA	Multilateral Investment Guarantee Agency
MMBtu	million British thermal units
MoE	Ministry of Energy
Mt	Megatonne
mtoe	million tonnes of oil equivalent
MW	Megawatt
µm	micrometer
µg	microgram
NAF	National Aid Fund
NGO	non-governmental organization
NOC	national oil company
OECD	Organization for Economic Co-operation and Development
OEE	Office of Energy Efficiency
p.a.	per annum
PM	particulate matter
PMT	proxy-means testing
PPP	purchasing power parity
PSA	project-sharing agreement
R&D	research & development
SCF	Strategic Climate Fund
SEC	specific energy consumption
SOE	state-owned enterprise
SSA	Sub-Saharan-Africa
TD	Tunisian dinar
TFC	total final consumption
toe	tonne of oil equivalent
TOU	time of use
TSP	total suspended particulates
TWh	Terawatt-hour
UAE	United Arab Emirates
UCT	unconditional cash transfer
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UK	United Kingdom
VAT	value added tax
WB&G	West Bank and Gaza
WBG	World Bank Group
WDI	World Development Indicators
WHO	World Health Organization
YR	Yemeni Rial

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Overview

Energy efficiency can improve fiscal balances, stimulate growth and competitiveness, strengthen energy security, and reduce the energy burden of the poor. It also can enhance the quality of life by improving energy products and services, reducing pollution, and reallocating savings from energy to social services and other welfare enhancements. From a long-term perspective, energy efficiency preserves energy resources for future generations and mitigates climate change.

Most governments in the region consider energy efficiency as a priority issue, although for different reasons. The key issue for many is the weight of energy subsidies in fiscal balances; for others, it is the vulnerability of the economy to swings in hydrocarbon prices and the risk of losing competitiveness; and for still others, it is concern about generating enough financing for energy investments and satisfying the energy demand of their fast-growing economies. These factors have prompted governments to renew their efforts to improve energy efficiency.

To sustain growth while improving the welfare of its citizens, the region must greatly improve its energy efficiency. Fortunately, significant opportunities exist to harness energy efficiency towards the region's development goals.

- Energy subsidies currently account for about 7.1 percent of the region's GDP. Reducing those subsidies could raise regional GDP by close to 2 percent.
- Improving energy efficiency by 20 to 50 percent could generate an additional 1 percent of GDP.
- Reducing losses in the transmission and distribution of electricity to 10 percent in all countries would save the region some 7,300 MW of power, equivalent to $5.5 billion of new investments.
- Capturing the 30 bcm of gas flared annually could save up to $2 billion each year.
- Reducing emissions of particulate matter could yield a gain of $5.3 billion a year, representing about 0.9 percent of the region's gross national income.
- Switching from incandescent lights to compact fluorescent lights could save thousands of megawatts of new power generation capacity and billions of investment dollars.

The region is now travelling on the path of energy efficiency improvement. These important results do not come easily, however. The decision to pursue energy efficiency is often politically difficult. The goal presents practical challenges and may not always yield the expected returns immediately. Sustained political and institutional commitment is required over several decades. Moving forward on energy efficiency requires a complex combination of pricing reforms with social protection, behavioral changes in all segments of society and sectors, and constant communications between governments and citizens.

This report explores opportunities to boost energy efficiency in the Middle East and North Africa and secure a sustainable energy future for the region. It explores governments' growing concern about the burden of energy subsidies and identifies opportunities to improve efficiency, drawing on regional and international experience. In so doing, the report addresses three concrete sets of questions:

- How does the region compare with other world regions in energy efficiency? Why has the topic moved to the top of the regional development agenda? How can the region integrate energy efficiency into fiscal management, energy security planning, and environmental policy? Why must energy efficiency be addressed across the entire economy?
- How can the region consolidate and advance the energy efficiency strategies already under way?
- How might the region capitalize on its own and on international experience to accelerate the implementation of energy efficiency policies and programs? What are the priorities? What support will be needed to convert the strategy into reality?

The organization of the report mirrors the three sets of questions posed above. Part I (chapters 1–3) makes the case for energy efficiency by drawing the profile of the region, and looking for opportunities to improve fiscal management, enhance national energy security, mitigate environmental damage, and align sectors of the economy. Part II (chapters 4–6) examines an array of complementary instruments that might be used in pursuit of energy efficiency, based on a foundation of economic incentives. This part of the report also takes stock of the main economic, institutional, financing, and technical instruments that have been used or are being introduced in the region. Part III (chapters 7–9) maps out a possible course for a regional energy efficiency strategy. Learning from the experience of countries outside the region that have performed well on energy efficiency, this section discusses possible priorities in the region, as well as the role that external partners like the World Bank might play.

The Profile of Energy Efficiency in the Middle East and North Africa

Since 1980, MENA's total final consumption of energy has grown faster than that of any other region in the world. That growth reflects the expansion of energy-intensive industries in the Gulf states, as well as the need to supply more electricity to growing populations. Today, the region's "energy intensity" is estimated at 0.18 toe per thousand U.S. dollars in 2005 PPP terms (/'000US$2005PPP), 60 percent higher than that of OECD countries (0.11toe/'000US$2005PPP), and 40 percent above the world's average energy intensity of 0.13.

The energy intensity of the region's economies is not explained simply by differences in their energy resources. Energy-abundant countries such as Iraq and UAE are among the most energy-intensive. But some energy-importing countries (for example, Lebanon and Jordan) also have quite energy-intensive economies. So do some other countries that are facing the gradual depletion of their fossil fuel reserves (for example, Syria and Yemen). At the same time, an energy-abundant country like Algeria has a fairly low level of energy intensity. Tunisia and Morocco fall below the world average (and even below the OECD average), while others are significantly above even the MENA regional average. There is no universal correlation between the natural resource endowment of the region's countries and their energy productivity.

With the continued rise in oil prices, energy intensity is dropping dramatically almost everywhere. OECD countries have experienced a steady decline in their energy intensity since the early 1970s. Only in the Middle East has energy consumption been rising faster than GDP. The region experienced a 73 percent rise in energy intensity between 1980 and 2001—a rate of 2.7 percent per year. That increase took place mostly during the early and mid-1980s, when energy intensity increased at an average of 6 percent per year.

Transmission and distribution losses in the power systems are high by industry standards—with the exception of Israel (2.8 percent) and Saudi Arabia (10.7 percent). For the other countries, losses range from 12.2 percent in Tunisia to 26 percent in Yemen. Reducing transmission and distribution losses in all these countries to 10 percent would provide an additional 7,340 MW of capacity equivalent, or a savings of US$5.5 billion equivalent in new investments.

Economic gains equivalent to 0.5 to 1 percent of GDP could be obtained by lowering the region's energy intensity.

Energy Efficiency and Health, Mortality and Quality of Life

The MENA Region has high levels of local airborne pollution (particulate matter - PM) and CO_2 emissions—far above levels found in OECD and other middle-income countries. The cost of such elevated levels of pollution is very high: close to 1 percent of the regional gross national income for particulate matter. Improved energy efficiency could substantially reduce pollution and the costs of pollution to the regional economy.

Within MENA, Iraq and Kuwait have the highest costs incurred by PM emissions—2.7 percent of GNI, more than five times the world average. With the exception of Yemen, Tunisia, and Morocco, most MENA countries have PM-emission damage costs that are higher than the world average. It is estimated that urban air pollution in eight MENA countries studied[1] causes 40,440 premature deaths per year. Among these eight countries, Egypt suffers the highest damage costs due to air pollution (2.1 percent of GDP), accounting for 44 percent of the total cost of environmental degradation in the country. Air pollution is the leading factor impacting health and quality of life in Egypt.

If a country undertakes an energy efficiency program that reduces per capita oil consumption by 10 percent, it can result in a 5.9 percent reduction in PM concentrations. We know the relationship between PM concentrations and mortality is complex, but assuming a 1:1 correlation between reduction in PM concentrations and premature deaths from air pollution, a 10 percent improvement in energy efficiency could save about 2,400 lives every year in the eight MENA countries.

Energy Efficiency, Energy Subsidies, and Fiscal Balance

Energy subsidies and energy efficiency have a two-way relationship. On the one hand, energy subsidies encourage the inefficient use of energy. On the other, energy efficiency reduces the cost of energy subsidies—for the simple reason that less energy is used.

Expressed as a percentage of GDP, average total energy subsidies amounted to at least 7.1 percent of the MENA region's GDP in 2006, ranging from 1.3 percent of GDP for Morocco, and 17.5 percent for Iran. In passing recent energy price increases through to consumers, MENA countries lag considerably behind other regions. In a sample of 14 developing and emerging market economies, the explicit subsidy

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[1] Algeria, Egypt, Iran, Jordan, Lebanon, Morocco, Syria and Tunisia.

increase averaged 1.5 percent of GDP but reached 9.3 percent of GDP (Yemen). By the end of 2007, the median pass-through of oil price increases for gasoline was the lowest in MENA.

Energy subsidies benefit the rich more than the poor, but they often represent an important part of poor people's incomes, especially for kerosene and butane. Energy subsidies have a low average impact on industrial costs, but some specific industries depend on energy subsidies for their survival.

Tunisia has shown how improved energy efficiency can produce subsidy savings. The energy efficiency gains achieved during 2005–2007 are now generating annual fuel savings of 390 thousand toe (tons of oil equivalent), which is 0.7 percent of total energy consumption. In turn this represents potential annual budgetary savings of TD 300 million (US$40 million) per year. Other countries in the region have higher subsidies and higher levels of energy intensity than Tunisia, so the potential fiscal savings are greater.

Energy Prices and Energy Efficiency

MENA countries have ample room to adjust energy prices so as to provide signals to consumers to use energy efficiently.

Take the example of light bulbs. Suppose that electricity costs $0.15 to supply and that households have the choice between a $5 energy-saving CFL bulb and a $0.75 incandescent bulb. If households choose the CFL, the economy will be $47 better-off per bulb in lighting cost after 5 years. But suppose that households are only charged $0.03 per kilowatt-hour (kWh) for this electricity. At $0.03 per kWh, it would take a household a year and a half to recover its investment in CFLs. After five years, the household would have saved only a third of its lighting costs—even though it would have used 75% less power. With electricity this cheap, the household would be quite unlikely to invest in the energy-efficient option. This example shows that when energy is subsidized, a rational choice for the user can be harmful to the nation.

For electricity, MENA residential rates average around $0.07/kWh, about a third of the corresponding rate for benchmark countries with full cost recovery. Within the region there is a wide variation between one high tariff country (Djibouti), other countries with financial cost recovery (Israel, Morocco, Tunisia, West Bank and Gaza), below-cost tariffs (Algeria, Jordan, Lebanon, Yemen, Iran and Syria) and extremely low tariffs (Bahrain, Egypt, Iraq, Kuwait, Libya, Oman, Qatar and Saudi Arabia).

It is not just the average level of tariffs that matters. Energy efficiency can also be encouraged through flexibility, transparency and differentiation in the tariff structure. Time of Use (TOU) tariffs are a particularly powerful instrument for regulating industrial electricity use, but only 7 out of 18 MENA countries apply them. Certain countries could focus on the tariff level, some on the tariff structure and some on both.

For liquid fuels, MENA's median prices for kerosene and diesel in 2006 were about half that of comparator countries with full cost recovery. Gasoline prices in MENA were closer to economic prices.

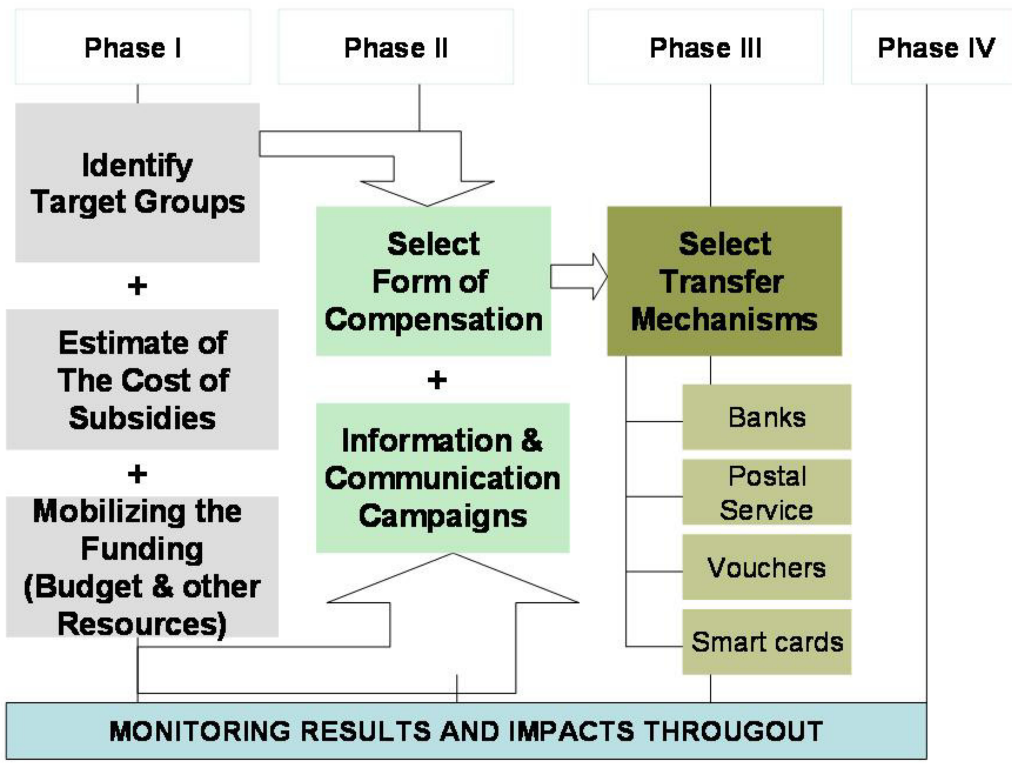
There is robust cross-country evidence for an inverse long-run relationship between energy prices and energy intensity. More econometric analysis is needed to estimate what the short- and medium-term demand response to higher prices would be in MENA.

Facilitating Energy and Subsidy Reforms for Energy Efficiency through Social Protection

Social protection and energy efficiency are mutually linked. For social and political reasons, price and subsidy reform requires effective social protection. Also integrating energy efficiency into social-protection programs can facilitate the implementation of energy-price reform.

Designing an effective social protection program requires analytical preparation. The key decisions involve the identification of the target groups, and selection of the form of compensation and the transfer mechanism.

Global experience shows that compensatory social protection does manage the social and political costs of energy price reform. Fuel subsidy reforms in middle-income countries (Brazil, Chile, Colombia, Indonesia, Turkey, Malaysia, China and India) shows the elements of success: analyzing, planning, targeting, timing and communicating.



Strengthening Institutional and Financing Frameworks for Energy Efficiency

Effective institutional arrangements make the most of a country's economic, technical, governmental, and political resources and capacities. There are two categories of required institutional arrangement: (a) *enabling frameworks*, which create the conditions necessary to undertake an energy efficiency campaign; and (b) *implementation arrangements*. The report details the key characteristics of each element, based upon the experience of countries in MENA and the rest of the world.

Enabling frameworks include laws and decrees, national energy plans, rules and regulations, and the existence of an apex agency for energy efficiency. Implementation arrangements include specialized agencies, programmatic arrangements, and other supporting arrangements (in other words the mobilization of a broad range of stakeholders). Energy Service Companies (ESCOs) and specialized financing arrangements have often been central to energy efficiency implementation.

The key principle is that there is no one single best approach. Each country must pick and choose the components of an institutional framework that match its policy objectives, resource endowments, institutional capacity, level of economic development and socio-political context.

Intervention strategies and institutional arrangements for energy efficiency in selected MENA countries

	Algeria	Egypt	Iran	Israel	Jordan	Kuwait	Lebanon	Morocco	Saudi Arabia	Syria	Tunisia
Intervention strategies identified											
Regulation	√	√	√	√		√				√	√
Pricing											
Incentives		√	√		√						√
Direct investment		√	√		√		√				
Market transformation	√		√	√	√			√	√	√	√
Technology development											
Industry development			√	√	√			√	√	√	√
Financial remediation	√		√					√			√
Enabling frameworks in place											
Energy efficiency laws and decrees	√			√					√		√
National energy plans		√	√	√	√			√		√	√
Energy efficiency regulations and rules	√	√	√	√	√	√				√	√
Apex agency for the energy sector	√	√	√	√	√	√	√	√	√	√	√
Implementation arrangements											
Energy efficiency agency	√		√	√	√	√	√			√	√
Programmatic arrangements	√		√	√			√	√	√	√	√
Financing arrangements			√					√			√
Other supportive arrangements	√	√	√	√	√	√	√	√	√	√	√
Results monitoring			√			√					√

At this time, only two countries in MENA have what might be deemed comprehensive institutional arrangements for energy efficiency: Iran and Tunisia. These two countries most closely approach the ideal both in their *enabling frameworks* (laws and decrees, national energy plans, regulation and rules, and an apex agency) and *implementation arrangements* (specialized agencies plus programmatic, financing, and other supportive arrangements). However, these frameworks are not always put into practice.

Several countries in MENA stand out as having a longstanding and sustained commitment to energy efficiency. These include Algeria, Israel, Kuwait, and Tunisia—all of which developed legislation and created agencies focused on energy efficiency in the mid-1980s.

Eight countries have created agencies to implement energy efficiency initiatives. Six of these agencies are dedicated solely to energy efficiency, and several have been in place for a long time, including Algeria's National Agency for the Promotion and Rational Use of Energy (established in 1985), the Iran Efficient Energy Organization (1994), the Infrastructure Resources Management Division of Israel's Ministry of National Infrastructure (1987), and the Rational Use of Energy Division of Jordan's National Energy Research Center (1998).

Another seven countries have promulgated rules and regulations for energy efficiency in production and consumption. Several more are developing some form of regulation of energy efficiency (usually appliance standards or building codes). Among the active regulatory regimes in the region are the following:

- In *Algeria*, thermal building codes apply to houses and commercial buildings. Energy audits for large consumers are mandatory.
- In *Egypt*, standards and labeling programs cover refrigerators, air-conditioners, and washing machines.
- In *Iran*, some appliances (refrigerators and air-conditioners), as well as new buildings, must meet energy efficiency requirements.
- In *Israel*, energy efficiency standards apply to refrigerators and air-conditioners. ESCOs must be licensed.
- In *Kuwait*, although effective, energy efficiency interventions and arrangements are narrowly focused on construction. An energy conservation code for all new buildings, promulgated by the MoE, ensures energy-efficient construction even though Kuwait's electricity prices are among the lowest in the world. The code of practice is overseen and enforced by the specialized Buildings and Energy Technologies Department of the Kuwait Institute for Scientific Research.
- In *Tunisia*, efficiency requirements are applied to buildings and appliances.
- In *Syria*, energy efficiency labels are required on refrigerators, air-conditioners, and washing machines. New houses and buildings must conform to a thermal insulation code
- In *Morocco*, the Framework Law on Renewable Energy and Energy Efficiency is being revised. The Renewable Energy Development Center, created in 1982, focuses on energy efficiency. Financing is available, mainly for solar water heaters, and an energy efficiency code for new construction is under development.

Managing the Transition: International Experience

In one way or another, many countries around the world have demonstrated their political commitment to increasing energy efficiency. Good practices include five key operational elements: long-term commitment and institutional development; the right entry points and the right pace of policy change; mobilization of sustained financial resources; effective, sustained measurement of results; and, most importantly, communication with the public.

The experience of Brazil, Japan and China shows that a combination of pricing and institutional policies can bring about quite remarkable energy efficiency gains in the medium to long term. In Brazil, a demand management campaign reduced total electricity consumption by 10%, a good illustration of behavioral changes as a result of effective communications and incentives. In 2002, average residential consumption stood at its 1994 level. Likewise, Japan has been able to achieve a 40% reduction in energy intensity since the early 1970s and aims to reduce it by another 30% by 2030. From 1980 to 2001, China's energy intensity improved by 68%. This was partly due to energy pricing reforms, which began in the 1980s. Major energy-intensive industries improved efficiency by 20-60%, while the trucking sector experienced a 14% increase in oil-consumption efficiency. China aims to reduce its energy intensity by another 20% by 2010.

Indonesia and Jordan were able to implement major increases in energy prices with limited socio-political repercussions by deploying social protection instruments and communication. Jordan's experience illustrated that:

- Careful planning and the robust analysis of stakeholder groups, options, and budgetary needs must take place before reform measures are announced.
- Stakeholder consultation and participation foster broad-based commitment to reform.
- Well-designed social-assistance and "economic protection" schemes help mitigate impacts on consumers *and* producers.
- Unless social benefits are accurately and narrowly targeted, fiscal savings from energy efficiency can be easily dissipated.
- Reforms are best introduced in a favorable economic environment. Jordan experienced strong economic growth during the reform period; high export prices in particular helped cushion the impact on domestic producers.

Realizing the Potential for Technical Improvement at the Sector Level

Studying specific energy-using sectors reveals the large gains available from improved energy efficiency, the obstacles to energy efficiency and possible ways to overcome these obstacles. The experience of MENA's manufacturing, construction, transport and irrigation sectors shows that:

- energy efficiency investments give very high returns, both in the short and long-term,
- mobilizing the main consuming sectors in improving their energy efficiency profile is indispensable, and
- energy solutions chosen today determine the energy efficiency profile of tomorrow.

The four most energy-intensive manufacturing industries in the region are cement, glass, fertilizers and steel. Among them, these industries consume some 25 percent of energy in West Asia. Returns to energy efficiency programs in industry are usually quite high, and the payback period relatively short. In Egypt, actual payback periods for energy efficiency investments were in the range 2.5 to 4.5 years. In Jordan it is estimated that the potential for cogeneration is around 150 MW for the industrial sector and around 50 MW for the commercial sector. In Morocco, energy savings in the industrial sector are estimated at 15-20 percent of its current energy consumption.

Buildings are estimated to be responsible today for at least 40 percent of energy use in most countries, with this figure rapidly increasing in all countries. Construction investments have 'a long life', spanning over centuries. Therefore, the energy choice in the construction industry of today determines the energy profile not only of the next decade or two, but of future centuries. Achieving energy efficiency in construction standards is critical from the perspective of household budgets, enterprise costs in the service industries, and fiscal expenditures on public buildings. In Morocco, it has been estimated that there is a potential for 10-30 percent efficiency gains in buildings. MENA is now at a critical juncture. At least half of the countries are in the process of updating, drafting, or adopting new energy efficiency building codes.

MENA is the most transport-energy intensive region in the world, consuming about 66 grams oil equivalent for each dollar of GDP generated. Indexed to world averages (100), MENA scores 165, while MENA countries with GDP per capita over $10,000 score 208. Thus, the economies of MENA countries are 13 percent more transport energy intensive than those of the United States and Canada combined, 65 percent more transport energy intensive than the world average, and nearly four and a half times more transport energy intensive than China's economy. A package of measures to bring down energy intensity could include fuel price increases, transport demand management, public transport investment, vehicle fuel economy measures, pay-per-travel fee regimes for private vehicles, transport monitoring and integrated transport and urban planning.

Pumping for irrigation and drainage consumes 6 percent of total final use of electricity and diesel, more or less equivalent to 57 TWh for electricity, again with a significant spread across countries, from 1.1 percent in Iraq to 28.5 percent in Yemen, reflecting the range of water resources, irrigation technologies, and land availability for cropping. There are again three main groups of countries, those in which irrigation pumping consumes:

- Less than 5 percent of electricity and diesel: Algeria, Iran, Iraq, Jordan, Lebanon, Morocco, Oman, and Tunisia.
- Between 5 and 10 percent: Egypt, Syria, Libya and Saudi Arabia.
- More than 20 percent: Yemen.

The total energy cost of pumping is estimated at US$4.3 billion in economic terms, which represents about 9% of agriculture value-added. In Yemen, the energy economic cost of irrigation and drainage is more than 30% of total value added of the agriculture sector. In Saudi Arabia, Jordan, Oman, Syria, Iran, and Iraq, it is 15, 12, 10, 8, 7 and 7 percent, respectively. In the current context, many opportunities exist to improve MENA's energy efficiency profile in irrigated agriculture, ranging from switching from diesel to electricity where feasible, improving pumping efficiency, either through redesign or equipment renewal, and switching irrigation technology. However, farmers' willingness to make these changes will be low at current subsidized energy prices.

Sector	**EE Improvement Opportunities**
Industry	Industrial processes, cogeneration, waste heat recovery, pre-heating, efficient drives
Buildings and municipal services	Building design and measures such as better insulation, advanced windows, energy efficient lighting, space conditioning, water heating, and refrigeration technologies. District heating systems, combined heat and power, efficient street lighting, efficient water supply, pumping, and sewage removal systems.
Transport	Efficient vehicles, urban mass transport systems, modal shifts to inter- and intra-city

	rail and water transport, CNG vehicles, traffic demand management
Agriculture	Efficient irrigation pumping and efficient water use, such as drip irrigation.

Entry Points and Sequencing

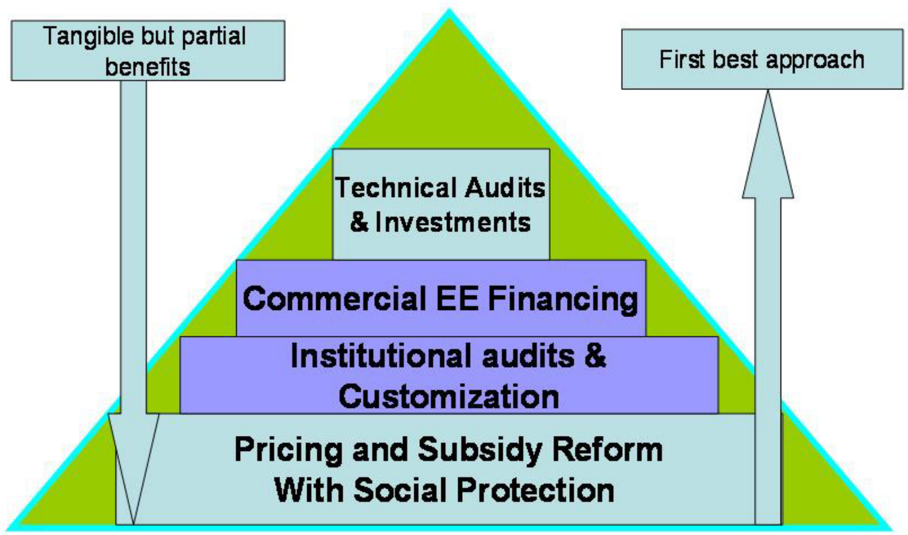
So MENA can now envision an energy-efficient future. Energy efficiency can help MENA achieve its development goals in terms of growth, competitiveness, welfare, and social development. Energy efficiency can also improve energy security for countries, enterprises and households. Energy efficiency is good business, with high returns on investments. Other gains include reduced air pollution. There are concrete examples of countries that have overcome the political obstacles to policy reform with social protection measures, and which have induced behavioral changes through balanced packages of incentives and effective communications.

Does the *sequencing* of interventions matter? The answer depends on the political economy of the region and of individual countries.

International experience underlines that countries that have obtained significant results on energy efficiency successfully did so by aligning economic incentives, institutions, financing and technical options. Pricing reform-with-social protection is the most difficult but also the highest priority intervention. Energy pricing establishes the foundations for the efficient production and use of energy. As seen from regional and international experience, efforts undertaken on energy efficiency -- be they technical or institutional -- have yielded incomplete results until prices provided energy producers and consumers the right economic signals. Complementary social protection interventions facilitate implementation.

However, implementation of pricing reform is complex and politically difficult, and preparation of the reform can take time. Meanwhile, other institutional and regulatory interventions can start, technical solutions can be adopted, and yield partial but positive results. It boils down to a choice between a first-best approach and a lower-risk, lower-return approach. The choice of path lies with each country.

Whichever route is chosen, the World Bank Group (WBG) stands ready to accompany MENA countries with lending and other financing instruments and advisory services. It also stands ready to jointly account for results.



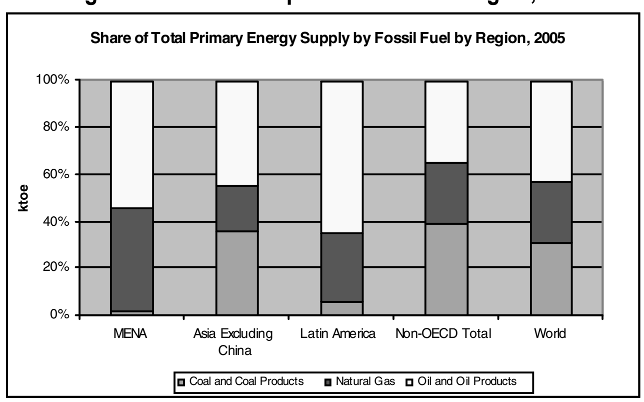
Chapter 1: A Profile of Energy Efficiency in the Middle East and North Africa

How efficiently is energy produced and consumed in the Middle East and North Africa (MENA)? The report addresses that question by comparing MENA with other world regions, using a benchmarking approach. The yardsticks employed for this exercise are reviewed in the first four sections below, which (a) provide data on energy production and use; (b) compare the region's energy intensity with that of other countries in the world; (c) compare energy production losses; and (d) assess end-user efficiency. The chapter's final section analyzes the trend in energy efficiency, assuming that present patterns in demand, supply, and trade continue over the next 10 to 15 years.

Patterns of Energy Supply and Consumption

Nearly all the region's primary energy comes from indigenously produced fossil fuels. The region uses about 7 percent of the world's total fossil fuel energy, 98 percent of which comes from oil and natural gas, compared with 69 percent for the world overall (figure 1.1). Two countries—the Islamic Republic of Iran and Saudi Arabia—account for almost half (48 percent) of the region's total primary energy supply from fossil fuel of 654 mtoe (table 1.1).

Figure 1.1.Mena is dependent on oil and gas , 2005



Source: IEA database

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Table 1.1. Total primary energy supply from fossil fuels in MENA and other world regions, 2006

Region / country	Coal and Peat		Crude oil & Petroleum Products		Gas		Total
MENA country	*ktoe*	*%*	*ktoe*	*%*	*ktoe*	*%*	*ktoe*
Islamic Republic of Iran	1,274	0.8	79,121	47.0	88,030	52.3	168,425
Saudi Arabia	-	-	92,478	63.3	53,623	36.7	146,101
Egypt	871	1.5	31,266	52.2	27,774	46.4	59,911
United Arab Emirates	-	-	13,202	28.1	33,751	71.9	46,953
Algeria	713	1.9	11,956	32.7	23,937	65.4	36,606
Iraq	-	-	28,981	91.0	2,858	9.0	31,839
Kuwait	-	-	15,604	61.7	9,687	38.3	25,291
Israel	7,669	37.0	11,155	53.9	1,881	9.1	20,705
Libya	-	-	12,391	70.4	5,218	29.6	17,609
Syria	3	0.0	13,460	72.5	5,104	27.5	18,567
Qatar	-	-	3,227	17.8	14,887	82.2	18,114
Oman	-	-	4,994	32.4	10,430	67.6	15,424
Morocco	3,879	29.4	8,844	67.0	479	3.6	13,202
Bahrain	-	-	2,158	24.6	6,616	75.4	8,774
Tunisia	-	-	4,125	54.5	3,442	45.5	7,567
Jordan	-	-	5,016	71.5	2,003	28.5	7,019
Yemen	-	-	7,016	100.0	-	-	7,016
Lebanon	132	2.9	4,351	97.1	-	-	4,483
Region	*Mtoe*	*%*	*Mtoe*	*%*	*Mtoe*	*%*	*Mtoe*
MENA	14,541	2.2	349,345	53.4	289,720	44.3	653,606
Asia excluding China	352.67	37.5	401.98	42.7	186.16	19.8	941
Latin America	21.91	6.0	236.84	64.9	105.93	29.0	365
Non-OECD Total	1,914.89	40.3	1,636.29	34.5	1,197.57	25.2	4,749
World	3,053.54	32.2	4,028.66	42.5	2,407.82	25.4	9,490

Source: IEA 2008

Energy Efficiency at the Macroeconomic and Sector Levels

The region consumes about 30 percent of its production of fossil fuels, and exports the rest. Countries range from very high levels of exports to very high import-dependence.[2] Of the 19 countries in the region, six—Djibouti, Israel, Jordan, Morocco, Tunisia, and West Bank and Gaza—depend heavily on imports.

[2] In 2003, the share of oil exports was 77%, and of gas 25%; the consumption mix was 75% oil, 20% gas, and 5 percent coal and renewables.

Since 1980, MENA's total final consumption of energy has grown faster than that of any other region in the world. That growth reflects the expansion of energy-intensive industries in the Gulf states, as well as the need to supply more electricity to growing populations (USEIA, 2007).

Today, the region's "energy intensity" is estimated at 0.18 toe per thousand U.S. dollars in 2005 PPP terms (/'000US$2005PPP), 60 percent higher than that of OECD countries (0.11toe/'000US$2005PPP), and 40 percent above the world's average energy intensity of 0.13. Among world regions, MENA ranks second in energy intensity after Eastern Europe and Central Asia (ECA) (table 1.2).

Table 1.2. MENA region ranks second in energy intensity

toe/'000 (US$2005PPP)

Country / region	GDP (billions of 2005 US$, PPP)	Total energy consumption (Ktoe, 2005)	Energy intensity toe/'000 (US$2005PPP)
MENA	**2,345.9**	**422,305**	**0.18**
East Asia and Pacific	11,320.0	1,462,624	0.13
Europe and Central Asia	2,753.6	685,919	0.25
Latin America and Caribbean	3,538.8	386,469	0.11
OECD	34,000.9	3,852,784	0.11
World	61,247.2	7,911,699	0.13
Lower middle income	13,707.2	1,822,958	0.13
Upper middle income	5,618.0	931,782	0.17

Source: WDI database and IEA database

What does energy intensity mean? An economy's energy intensity is the ratio of its energy use to its GDP. GDP is often measured in terms of purchasing power parity (PPP), meaning that it is adjusted for differences in the cost of living from one country to another. The reciprocal of energy intensity, GDP per unit of energy, is called *energy productivity.* High energy productivity is the same as low energy intensity.

Countries with low energy intensity may specialize in economic activities that do not use much energy (the so-called sector effect), or they may use energy efficiently (the energy efficiency effect). It is very difficult to measure the two effects separately. Doing so would require very detailed data on the subsectoral composition of the economy and of energy use. Energy efficiency *can* be measured at the micro level—for example, how much energy it takes to produce a ton of cement—but cannot be aggregated at the country level.

High energy intensity is therefore used as a sign of possible energy inefficiency. Energy intensity and energy inefficiency often go together, but they are not the same thing (Box 1).

Box 1. Energy Efficiency, Energy Conservation, and Energy Intensity

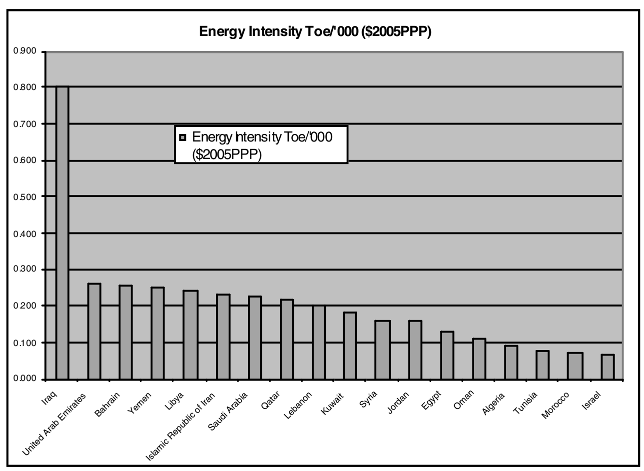
Energy efficiency, energy conservation, and energy intensity, are terms often used quasi interchangeably. Yet, they have different meanings, use, and impacts. **Energy efficiency** refers to the use of primary or secondary energy to produce a good or a service. For example, a petroleum refinery that uses less oil to produce the same or a greater quantity of refined products (gasoline, diesel etc.) than another refinery will be considered more energy efficient. Likewise, a compact fluorescent light-bulb of 13 watts which gives the same lumen output as a 60 watt incandescent light is more energy efficient. **Energy Conservation** results either from using more efficient equipment, such as CFL light bulbs or less energy consuming machinery, or of changing behaviors, such as switching from motorized to non-motorized transport, or switching lights off when leaving premises. Energy conservation is important from a resource base and economic perspective, as well as from a climate change perspective. The less fossil fuel resources are consumed at time t, the less CO2 emissions, and the more resources will be available for future generations.

Energy intensity is simply a way of measuring energy use in an economy. It is expressed as the ratio of a country's total energy use to GDP. The reciprocal of energy intensity, GDP per unit of energy, is called *energy productivity.* High energy productivity is the same as low energy intensity. The energy intensity of an economy is derived from both the structure of its economy, whether energy intensive sectors are large contributors to its GDP and to the efficiency of energy use in each of the consuming sectors. Energy intensity is therefore a useful measure to compare economies and trends, it is not a value judgment on the choice of a specific economic structure. It does allow decision makers to look at alternative patterns of energy consumption for a certain rate of economic growth and to maintain the competitiveness of their economies.

The energy intensity of the region's economies is not explained simply by differences in their energy resources. Energy-abundant countries such as Iraq and UAE are among the most energy-intensive (figure 1.2 and table 1.3). But some energy-importing countries (for example, Lebanon and Jordan) also have quite energy-intensive economies. So do some other countries that are facing the gradual depletion of their fossil fuel reserves (for example, Syria and Yemen). At the same time, an energy-abundant country like Algeria has quite a low level of energy intensity. Tunisia and Morocco fall below the world average (and even below the OECD average), while others are significantly above even the MENA regional average (WEC, 2008). There is no universal correlation between the natural resource endowment of the region's countries and their energy productivity (table 1.4).

Figure 1.2. Energy intensity in the countries of the region

toe/'000 ($2005PPP)



Source: WDI database

Table 1.3. Energy intensity in MENA, by country (Toe/'000US$2005PPP)

Region / country	GDP (billions of 2005 US$, PPP)	Total energy consumption (ktoe, 2005)	Energy intensity (toe/'000US$2005PPP)
MENA	2,345.9	422,305	0.18
Algeria	231.5	21,872	0.09
Bahrain	15.6	4,015	0.26
Egypt	320.3	41,590	0.13
Islamic Rep. of Iran	542.5	127,348	0.23
Iraq	29.3	23,507	0.80
Israel	178.6	12,707	0.07
Jordan	30.2	4,859	0.16
Kuwait	66.6	12,377	0.19
Lebanon	19.9	4,057	0.20
Libya	46.1	11,235	0.24
Morocco	137.1	10,350	0.08
Oman	39.8	4,522	0.11
Qatar	35.0	7,685	0.21
Saudi Arabia	362.4	82,787	0.23
Syria	72.3	11,679	0.16
Tunisia	83.8	6,434	0.08
United Arab Emirates	115.4	30,322	0.26
Yemen	19.5	4,956	0.25

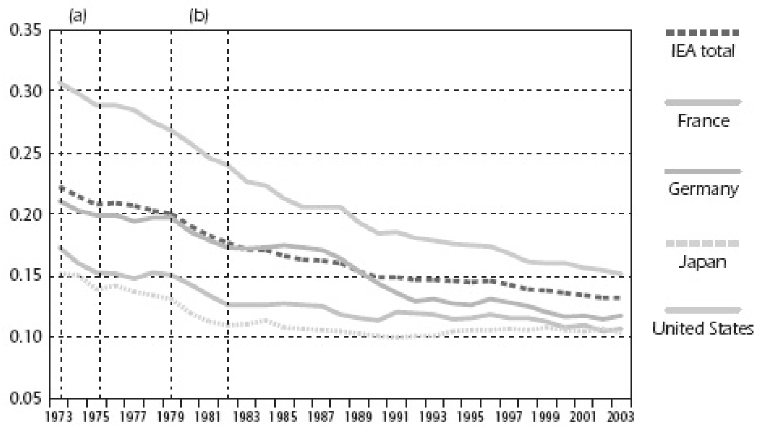
Source: IEA database and WDI database

Table 1.4. Distribution of energy intensity in MENA countries

Countries	Below world average energy intensity <0.13	At or above world average energy intensity >0.13	Data not available
Resource-rich	Algeria, Egypt, Oman	Bahrain, Iran, Iraq, Kuwait, Libya, Qatar, Saudi Arabia, Syria, UAE	
Resource-poor	Israel, Morocco, Tunisia	Jordan, Yemen, Lebanon	West Bank & Gaza
Other	—	—	Djibouti

With the continued rise in oil prices, energy intensity is dropping dramatically almost everywhere. OECD countries have experienced a steady decline in their energy intensity since the early 1970s (figure 1.3).

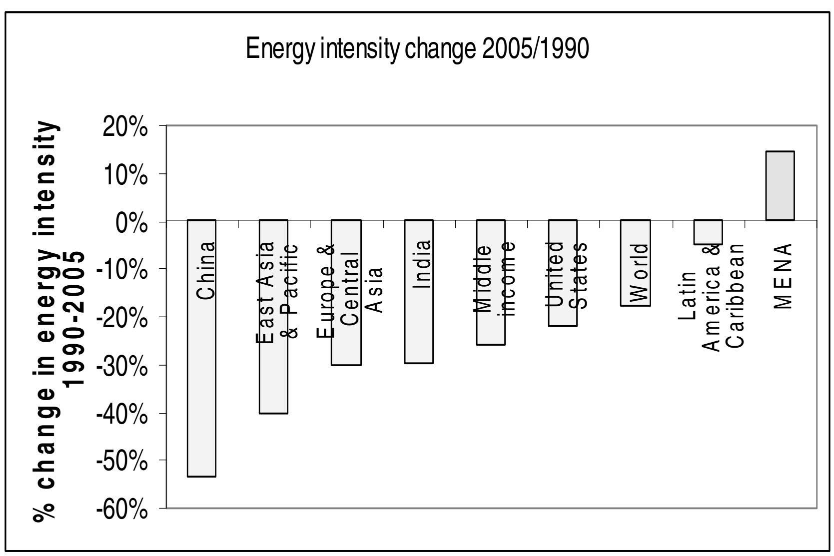
Figure 1.3. Energy intensity has declined in OECD countries, 1973–2003



a) corresponds to the first oil shock (end 1973) and macro-economic recession induced by this shock.
b) corresponds to the second twin oil shock (early 1979 and end-1980) and the macro-economic recession induced by this double shock.
Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2005 and *National Accounts of OECD Countries*, OECD Paris, 2005.

Only in the MENA has energy consumption been rising faster than GDP (figure 1.4). The region experienced a 14% rise in energy intensity between 1990 and 2005—a rate of nearly 1 percent per year. Some countries have fared better than others. Israel departed from this trend, with a 5 percent decline over the same period. Tunisia's energy intensity has experienced a steady decline since 1990, reaching 0.08 (figure 1.5).

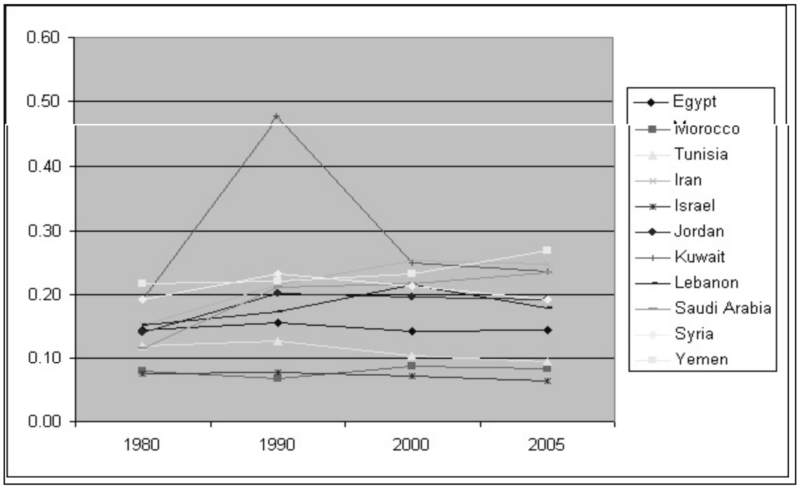
Figure 1.4. Change in primary energy intensity by world region, 1990-2005



Source: WDI database

Figure 1.5. Some MENA countries fared better than others on energy intensity,

1980-2005 (in US$1995PPP)



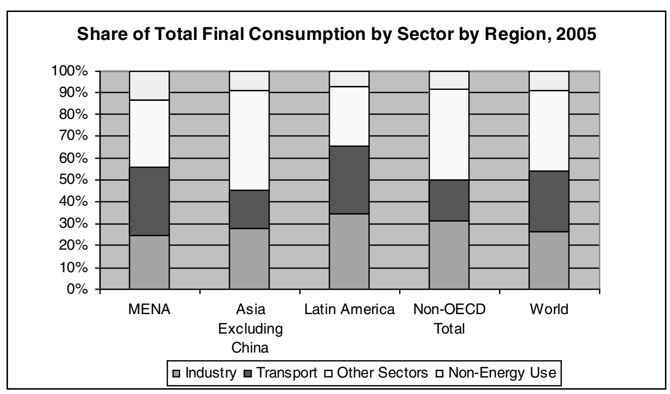
Source: ENERDATA-WEC/ADEME, 2007.

The good news is that energy intensity can improve. China, which had the highest energy-intensity level in 1980, experienced the strongest improvement in energy productivity—around 5 percent per annum (p.a.), on average, and even 7.5 percent p.a. between 1990 and 2000. China's energy intensity is now slightly above world average; in 1990 it was 80 percent *higher* than the world average. China's improvement proceeded from various factors, including its more efficient use of coal, fuel-switching from coal to oil and gas, industry restructuring, and higher energy prices (see chapter 7 for more details).

The world's regions also vary in energy intensity at the sectoral level. MENA is by far the most energy-intensive region in the residential sector, ahead of ECA, and it is second after ECA in manufacturing (table 1.5).

In terms of total final consumption by sector (figure 1.6), the transport sector accounts for 31 percent of all energy consumed in the MENA region. This is slightly above the world average of 28 percent, but well above Asia (excluding China) and non-OECD countries. In other words, MENA's energy use is more weighted towards transport than most developing countries, in large part because of the rapid expansion of private car ownership in oil rich countries.

Figure 1.6. Share of total final consumption by sector and region, 2005



Source: IEA database.

Table 1.5. Energy intensity and CO_2 emissions for the residential and manufacturing sectors in MENA and other regions

Region/Group	Energy consumption per unit of GDP per capita in residential sector (ktoe/2005 PPP $)	Energy consumption per dollar of manufacturing output (kg/2005 PPP $)	CO_2 emission per dollar of manufacturing output (kg/2005 PPP $)	CO_2 emission per unit of GDP per capita (t of CO2/2005 PPP $)
MENA	88.84	0.33	0.99	79,960.22
East Asia and Pacific	19.85	0.16	0.51	19,995.41
Eastern Europe and Central Asia	73.96	0.43	0.89	47,499.70
Latin America and Caribbean	8.40	0.21	0.36	7,278.23
Lower middle income	21.81	0.18	0.57	26,264.66
Upper middle income	13.07	0.29	0.55	23,597.00

Source: IEA database and WDI database

Two issues of specific importance for MENA are gas flaring in the oil-production sector and transmission and distribution losses in the power sector.

Gas flared in the oil and gas industry of the Middle East is estimated to amount to 30 billion cubic meters (bcm) per annum, the third-largest volume after Russia (60 bcm) and Africa (45 bcm) (GGFR, 2007). Gas flaring represents a lost opportunity for the region, with losses estimated at US$1–2 billion per year.[3]

Transmission and distribution losses in the power systems are high by industry standards—with the exception of Israel (2.8 percent) and Saudi Arabia (10.7 percent). For the other countries, losses range from 12.2 percent in Tunisia to 26 percent in Yemen (table 1.6). Reducing transmission and distribution losses in all these countries to 10 percent would provide an additional 7,340 MW of capacity equivalent, or a savings of US$5.5 billion equivalent in new investments.[4]

Table 1.6. Electricity transmission and distribution losses in 11 MENA countries

Country	%	Installed capacity (GW)	Potential savings (GW)
Egypt	14.0	18.5	0.74
Iran	16.7	42.7	2.80
Israel	2.8	10.1	
Jordan	13.7	1.9	0.07
Kuwait	12.2	9.4	0.21
Lebanon	15.4	2.5	0.14
Morocco	12.6	5.1	0.13
Saudi Arabia	10.7	30.4	2.13
Syria	23.7	6.5	0.89
Tunisia	12.2	3.3	0.07
Yemen	26.0	1.0	0.16

Source: ENERDATA-WEC/ADEME, 2007.

3 At an average price of US$15–25/t CO2, and 1 bcm of gas flared = 2.62Mt $\mathbf{CO_2}$ equivalent.
4 At a conservative investment cost of $735,000/mw.

Rising Energy Demand

Energy demand in the region is expected to continue to grow at a very high rate over the next decade. The economies of the region are expected to grow at an average annual rate of about 5 percent (World Bank, 2008). As GDP grows, energy demand accelerates. (The elasticity of energy demand to GDP growth for Saudi Arabia, for example, was 1.4 during 1985–2001.) The International Energy Authority (IEA) estimates that energy demand will grow at close to 3 percent over the next two decades or so (table 1.8). If those estimates prove to be correct, MENA will account for 7.5 percent of global primary energy demand in 2030, an increase of two percentage points over the region's 2003 level (IEA, 2005). Demand for electricity, including for desalination, is estimated to increase by about 3.4 percent annually. Meeting the forecast level of demand growth will require major investments.

Table 1.8. Projected energy demand in the MENA region, 2004–30

Indicators	2004	2010	2020	2030
GDP (billion dollars 2004 using PPPs)	1,970	2,640	3,661	4,870
Population (million)	323	370	441	505
Per capita energy demand (toe/capita)	1.8	2.0	2.3	2.4
Energy intensity (toe/thousand dollars of GDP in 2004 prices and PPPs)	0.29	0.29	0.28	0.25

Source: IEA, 2005

Estimating Opportunities from Improved Energy Intensity

Energy efficiency improvements can have very high returns. For example, in Lebanon, $10 million invested in switching 5 million incandescent lights to CFLs would save about $250 million of investment in the equivalent of a 250MW power plant. To get a sense of the potential macro-level benefits of improving energy efficiency, various levels of energy efficiency gains using the model developed by the Global Trade Analysis Project (GTAP) were simulated (with some adjustments of the model).[5] Increasing energy efficiency by 20 percent throughout, the region's economy would generate overall GDP gains of US$11 billion (2004 prices). Almost half of these benefits (48 percent) would accrue to four countries: Iran, Egypt, Morocco, and Tunisia (table 1.9). Energy efficiency improvements of 10 to 50 percent would yield GDP benefits ranging from $6 to $23 billion for the Region. Illustrations of similar benefits are provided in chapter 7 which reviews good practices from the international experience.

[5] For a description of the model, see Martina Brockmeier, *Graphical Exposition of the GTAP Model.* Purdue University. Revised March 2001. www.agecon.pudue.edu/gtap/. In the original GTAP model, energy inputs appear within a composite materials input that is used in fixed proportions with a composite primary factor bundle. To allow for substitution between energy, factor inputs and other materials, the model was modified. An energy intermediate that substitutes with value-added and with a composite of other inputs in the production of each good was introduced. An elasticity of substitution of 0.5 between the energy composite and value-added, and of 0.2 between these composite inputs and other materials was used. Elasticities of substitution for energy use of 0.7 and 0.3 were also used. Details are provided in Maros Ivanic and Will Martin, *Implications of Reforming Energy Use Policies in the Middle East and North Africa* (Washington, D.C.: World Bank, May 2008.)

Table 1.9. GDP Impact of various energy efficiency improvements (%)

US$ million					
Country / region // EE%	**10**	**20**	**30**	**40**	**50**
Iran	1,611	3,010	4,237	5,325	6,295
Egypt	751	1,406	1,983	2,496	2,955
Morocco	189	353	497	624	737
Tunisia	125	233	328	413	488
Rest of North Africa(XNF)	584	1,089	1,530	1,920	2,268
Rest of West Asia (XWS)	2,630	4,917	6,929	8,717	10,320
Total	5,890	11,008	15,504	19,495	23,063

Source: Ivanic M. and Martin W., 2008

Energy efficiency is important for men and women, but in different ways.

The different situation of men and women, both in the household and in business, means that energy use and energy efficiency will matter to them in different ways. To explore the issue of gender and energy efficiency, the World Bank commissioned studies in Tunisia and Egypt[6]. They confirmed that gender matters for energy use in the household, and for energy use in the business sector and therefore for the design of energy policies.

Male and female energy-users in the household. Energy is equally recognized by women and men as a significant item in household expenditures, even though few are well informed about energy savings and efficiency. The decision on the choice of fuel and household appliances is male-dominated, although women are very sensitive and informed on the relative energy efficiency of various appliances such as cooking stoves. Women also appear to have little say over the use of electricity for leisure and comfort appliances (radio, TV, fan, air-conditioner). In Cairo, women adjust to energy price increases by rationalizing energy consumption and discarding energy intensive home appliances such as deep freezers, electric stoves, and electric heaters. In both countries, poor women are the most hit by fuel price increases as they tend to have less income and participate less in income earning activities; they adjust to price hikes through self-rationing or, in the rural areas, switching back to inferior fuels (e.g., from kerosene to charcoal and wood). The poor, in general, rely more on public transport than higher income groups; women are at a particular disadvantage to use this mode of transport, both on account of cultural restrictions and risks of harassment.

[6] Funding for the studies was provided by the World Bank Gender Action Plan, and by ESMAP. Background papers: Dr. Suzanne Messiha: *Gender and Energy Efficiency in Egypt.* December 2008. Dr. Henda Gafsi: *Gender and Energy Efficiency in Tunisia.* February 2009. The studies consisted in carrying a set of individual interviews and focus in a cross section of consumers, enterprises, and agencies, in a small sample of large and small cities, and in rural areas.

Male and female entrepreneurs as energy users. In Egypt, men entrepreneurs seemed to be better informed than women, and already using energy conservation measures. In Tunisia, there were no significant differences in the approach to energy use between women-headed and men-headed SMEs. The differences were due to the type of economic activity, the size of the enterprise, and the type of energy used. Larger enterprises, using primarily petroleum fuels, and micro-agro-industrial enterprises were the most sensitive to energy price fluctuations.

Conclusion

The MENA region is 60 percent more energy intensive than the OECD countries and 40 percent more so than the upper-middle-income countries of the world, partly because of pricing policies. And, unlike anywhere else in the world, energy intensity is increasing in the region. Given current policies and projected economic growth rates, it is likely to continue to increase, which ultimately will lower the region's GDP by billions of dollars. By contrast, economic gains equivalent to 0.5 to 1 percent of GDP could be obtained by lowering the region's energy intensity.

Many countries in the region have embarked on a course to improve their energy efficiency. Others are concerned that their high level of energy consumption may be sapping their competitiveness, compromising their energy security, and damaging their environment. These questions will be explored in the next chapters.

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Chapter 2: Energy Efficiency and Health, Mortality, and Quality of Life

The MENA region has high levels of local airborne pollution (particulate matter) and CO_2 emissions—far above levels found in OECD and other middle-income countries—particularly in the manufacturing sector. Four MENA countries rank among the 11 countries worldwide with the fastest increase in emissions. The cost of such elevated levels of pollution is very high: close to 1 percent of the regional gross national income for particulate matter and about 1.3 percent of the regional GDP (2006) for CO_2 emissions (if these are valued at $15/ton),[7] or US$23.6 billion.

Improved energy efficiency could substantially reduce (1) pollution and (2) the costs of pollution to the regional economy.

The Environmental Impact of Energy Consumption in the Region

Energy consumption is the most significant source of pollution in MENA, as elsewhere in the world. Particulate matter affects the local environment, causes disease, and lowers the quality of life. In addition, energy use causes climate change through the emissions of greenhouse gases. This section first reviews the environmental impact of energy production and energy use on (1) particulate matter levels and (2) CO_2 emissions. It then discusses trends in energy use. Finally, it analyzes the potential environmental gains—for MENA's population and the wider world—of improved energy efficiency.

Particulate Matter

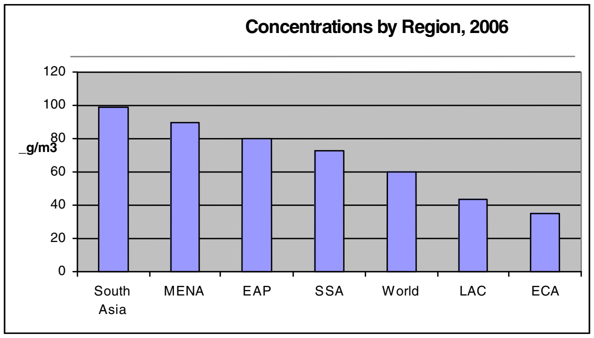
The burning of fossil fuels for power generation, transportation, industry, and other human activities produces a complex mixture of particulate matter (PM) and gaseous pollutants, with serious health consequences for the exposed population (Box 2.1). Fine particles less than 10 microns (μm) (PM_{10}), and especially less than 2.5 μm ($PM_{2.5}$), in diameter are considered the most harmful to health because they are small enough to be inhaled and transported deep into the respiratory system. They penetrate the lungs' thin membranes and lodge in the tissues. In urban areas alone, PM pollution accounts for approximately 800,000 premature deaths worldwide each year (WHO, 2002).

The concentration of PM_{10} (in micrograms per cubic meter, or μg/m3) is used in this report as the indicator of air pollution. In terms of PM concentrations, the MENA region is the second-most polluting region in the world, behind only South Asia (see Figure 2.1). The estimated PM concentration weighted by the share of the urban population [weighted average concentration = 90 μg/m3] is 50 percent higher

[7] For CO_2 emissions, see http://www.earth-policy.org/Indicators/CO2/2006_data.htm#fig3.

than the world average. Within the MENA region (Figure 2.2), Iraq has the highest PM concentration (167 µg/m3), followed by Egypt, Kuwait, Oman, Libya, the United Arab Emirates (UAE), and Saudi Arabia—all of which have levels above the region's average.

Figure 2.1. Particulate matter concentrations in MENA are above world average , 2006



Source: World Bank, 2006

Box 2.1. The Nature and Consequences of Particulate Matter

Particles in the air are classified by diameter size and chemical composition, and are often referred to as particulate matter (PM). This matter is generally measured in terms of the mass concentration of particles within certain size classes: total suspended particulates (TSP); PM_{10}, or coarse (with a diameter of less than 10 micron); $PM_{2.5}$, or fine (with a diameter of less than 2.5 micron), and ultrafine (particles with a diameter of less than 0.1 micron). The distinction between coarse and fine particles is important because they have different sources, formation mechanisms, compositions, atmospheric life spans, spatial distributions, indoor–outdoor ratios, temporal variability, and health impacts.

The health impacts of air pollution depend on the pollutant type, its concentration in the air, length of exposure, other pollutants in the air, and individual susceptibility. The evidence shows that even very low concentrations of air pollution damage the health of local people, especially those in the most susceptible populations—children and the elderly. The adverse health impacts of air pollution can be substantial. For example, in China in 1995, air pollution resulting from fuel combustion is estimated to have caused 218,000 premature deaths (equivalent to 2.9 million life-years lost), 2 million new cases of chronic bronchitis, 1.9 billion additional restricted-activity days, and nearly 6 billion additional cases of respiratory symptoms (World Bank, 1997). The primary culprit is believed to have been fine PM.

Urban air pollution also causes diseases such as lung cancer, cardiovascular ailments, and respiratory conditions, including infections. The World Health Organization estimates that urban PM accounts for about 5 percent of trachea, bronchus, and lung cancer cases; 2 percent of deaths from cardiorespiratory conditions; and 1 percent of respiratory infections. Worldwide, this amounts to about 0.8 million deaths annually, with the majority in developing countries (WHO, 2002).

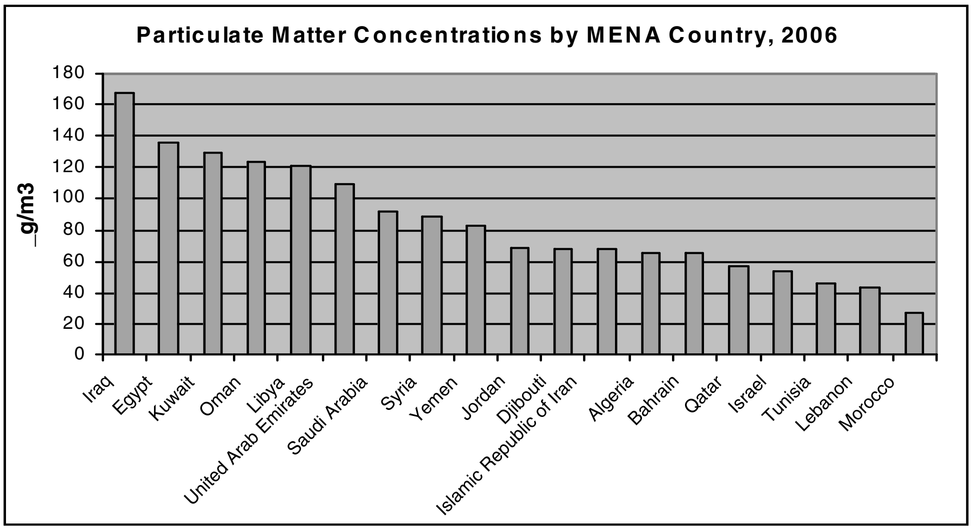
While some developing countries still monitor only TSP, a growing number of urban centers are focusing on finer categories—PM_{10}, $PM_{2.5}$, and/or $PM_{0.1}$. This shift in focus is necessary because fine particles have more damaging health effects.

The adverse impacts of PM pollution extend beyond the direct health impacts discussed above. For example, PM can scatter and absorb solar radiation, and directly contribute to climate change by reducing ground-level solar radiation. An excessive number of airborne particles can change cloud properties, and thus the hydrological cycle, impacting rain patterns. Particulate pollution can also impact visibility (i.e., via haze or smog), damage buildings, and destroy vegetation.

Source: ESMAP, 2008

An estimate of PM concentrations was prepared using the Global Model of Ambient Particulates (GMAPS) (Cohen et al., 2004) developed at the World Bank. The GMAPS is used to estimate PM_{10} concentrations in cities with a population greater than 100,000. The model employs econometrics and the latest data from an international sample of cities available from the World Health Organization (WHO) and other sources. Details on the model are provided in Appendix 2.1.

Figure 2.2. Iraq faces top PM levels in MENA. Then come Egypt and Kuwait. , 2006



Source: World Bank, 2006

The damage caused by PM concentrations in MENA is quite costly—estimated at 0.9 percent of the 2004 GNI (about US$5.3 billion).[8] The MENA region ranks the second highest after the East Asia and Pacific region, and well above the world average of 0.5 percent (see Table 2.1 and Figure 2.3). Within the MENA region (see Table 2.1 and Figure 2.4), Iraq and Kuwait have the highest costs incurred by PM emissions—2.7 percent of GNI, more than five times the world average. With the exception of Yemen, Tunisia, and Morocco, most MENA countries have PM-emission damage costs that are higher than the world average.

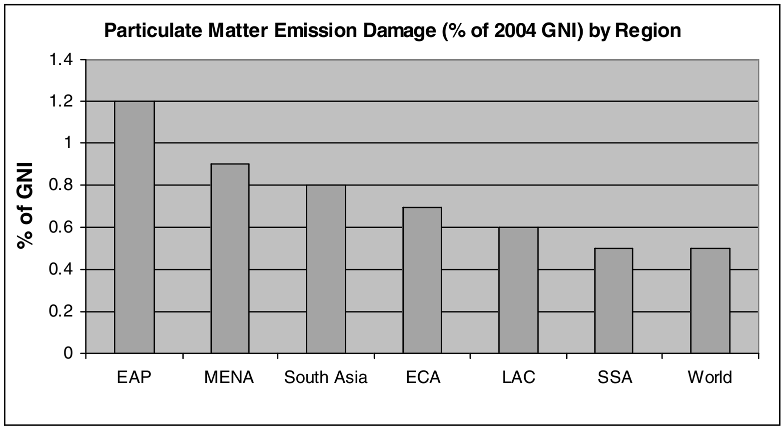
[8] 2005 GNI figures were not available at the time of writing this report.

Table 2.1. PM Concentrations and Damages by MENA Country and by Region

Country/Region	Particulate matter (urban-pop.-weighted avg., µg/m3)	Particulate emission damage (% of GNI)
MENA Country		
Iraq	167	2.7
Egypt	136	1.7
Kuwait	129	2.7
Oman	124	1.1
Libya	121	..
United Arab Emirates	109	2.5
Saudi Arabia	91	1
Syria	89	1
Yemen	82	0.5
Jordan	69	0.9
Djibouti	68	..
Islamic Republic of Iran	68	0.9
Algeria	65	0.7
Bahrain	65	0.6
Qatar	57	1.3
Israel	53	1.2
Tunisia	46	0.4
Lebanon	43	0.9
Morocco	27	0.3
Region		
EAP	80	1.2
MENA	90	0.9
South Asia	99	0.8
ECA	35	0.7
LAC	43	0.6
SSA	73	0.5
World	60	0.5

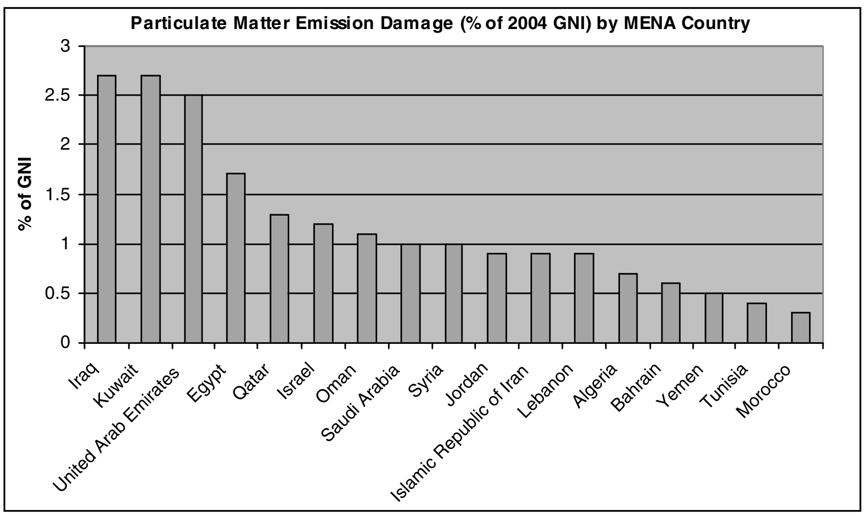
Source: World Bank, 2006

Figure 2.3. Damages from PM emissions are severe in MENA



Source: World Bank, 2006

Figure 2.4 Cost of PM emissions is high in Iraq and Kuwait, followed by the U.A.E., 2004



Source: World Bank, 2006.

Other estimates of the damage incurred by PM concentrations in MENA were prepared during the period 2001–2005 as part of the World Bank *Cost of Environmental Degradation Studies*, which covered eight MENA countries (World Bank, 2001, 2002, 2003, 2004a, 2004b, 2005a, 2005b). The studies analyzed the cost of environmental degradation as a percentage of GDP (with a focus on the health impacts of air pollution and waterborne illnesses), the economic cost of water resources and soil/land degradation, impacts related to waste management, and the cost of coastal zone degradation. The studies relied on existing data and environmental assessments, and applied commonly used evaluation methodologies to country-specific issues in order to estimate the cost of degradation.

It is estimated that urban air pollution in the eight MENA countries studied causes 40,440 premature deaths per year. Among the eight studied countries (Table 2.2), Egypt suffers the highest damage costs due to air pollution (2.1 percent of GDP), accounting for 44 percent of the total cost of environmental degradation in the country. Air pollution is the leading factor impacting health and quality of life in Egypt.

Table 2.2. Damage Costs of Air Pollution in Eight MENA Countries

Country	Reference Year	US$/Year (millions)	% of GDP	Number of estimated annual premature death due to urban air pollution	Total Disability Adjusted Life Years (DALYs)	% of overall estimated cost of environmental degradation to the country
Algeria	1999	446	0.9	N/A	157,000	26
Egypt	2001	1,890	2.1	20,000	450,000	44
Iran	2002	1,810	1.6	13,200	191,000	21
Jordan	2000	64	0.8	600	15,300	28
Lebanon	2000	170	1.0	350	9,000	30
Morocco	2000	340	1.0	2,300	73,000	28
Syria	2001	218	1.2	3,400	95,000	35
Tunisia	1999	121	0.6	590	15,000	28

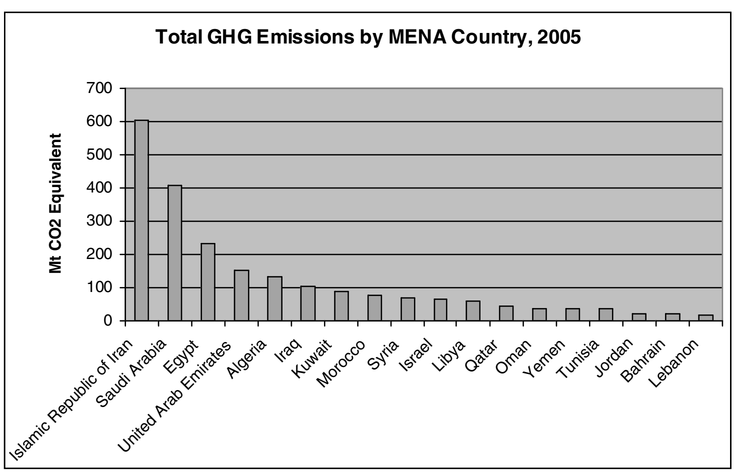
Source: World Bank staff. Data from: World Bank, 2001, 2002, 2003, 2004a, 2004b, 2005a, 2005b.

Note: Damage costs due to air pollution include both urban air pollution and indoor air pollution (IAP). IAP is minimal in Syria and Jordan, however, because there is nearly universal access to clean commercial fuels.

Greenhouse Gases

According to the IEA data, in 2005 the MENA region contributed 6 percent of the world's energy-related greenhouse gas (GHG) emissions—i.e., 2207.65 Mt of CO_2 equivalent. These emissions were concentrated in three countries—the Islamic Republic of Iran (27 percent), Saudi Arabia (18 percent), and Egypt (10 percent)—which together contributed 56 percent of emissions in the region (Figure 2.5). More than 50 percent of emissions came from oil combustion; very little came from coal when compared with the rest of the world (IEA/OECD, 2007).

Figure 2.5. Large variation in GHG emissions by country



Source: IEA/OECD, 2007

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When analyzed by sector, emissions in the MENA region do not follow the prevailing energy-consumption patterns of middle-income or developing countries (Table 2.3). As seen in chapter 1, the transportation sector accounts for 31 percent of total final consumption (TFC), slightly more than the world average of 28 percent, and well above consumption in Asia excluding China (17 percent) and non-OECD countries (17 percent). The industry sector accounts for 25 percent of TFC, comparable to the world average but less than for other regions with similar income and industrialization levels. The energy sector contributes almost 45 percent of emissions, followed by the transport sector (22 percent) and the industry sector (20 percent). The rate of emissions varies across countries: energy sector CO_2 emissions are greatest in Kuwait, transport emissions in Iraq, and industrial emissions in the UAE (OECD/IEA, 2007).

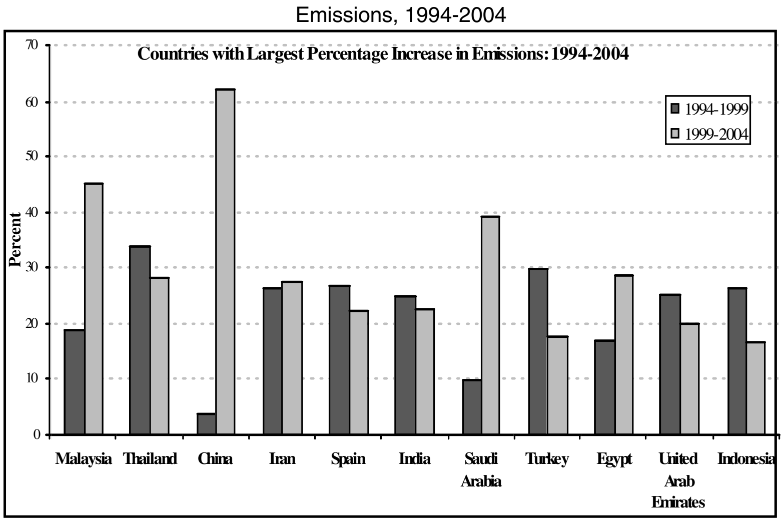
Table 2.3. CO2 Emissions by Sector, 2005

Country/Region	Energy Sector		Manufacturing Industries and Construction		Transport		Other Sectors		Total
MENA Country	Mt of CO2	%	Mt of CO2	%	Mt of CO2	%	Mt of CO2	%	
Islamic Republic of Iran	108.14	27	76.44	19	100.31	25	122.21	30	407.10
Saudi Arabia	171.98	54	71.44	22	72.52	23	3.74	1	319.68
Egypt	61.56	42	37.41	25	31.59	21	17.03	12	147.59
United Arab Emirates	53.08	48	31.52	29	22.06	20	3.72	3	110.38
Iraq	29.08	34	17.54	21	29.63	35	8.39	10	84.64
Algeria	35.59	42	11.18	13	17.78	21	19.75	23	84.30
Kuwait	50.14	67	12.42	17	8.04	11	4.02	5	74.62
Israel	40.27	67	1.81	3	9.86	16	7.91	13	59.85
Syria	22.30	47	9.78	20	11.74	25	3.94	8	47.76
Libya	23.60	52	7.31	16	11.72	26	2.77	6	45.40
Morocco	18.03	44	7.16	17	1.82	4	14.34	35	41.35
Qatar	21.05	58	9.04	25	6.14	17	0.14	0	36.37
Oman	17.08	63	5.10	19	3.61	13	1.19	4	26.98
Tunisia	6.78	35	3.85	20	4.54	24	4.11	21	19.28
Yemen	5.76	31	1.83	10	6.18	33	4.92	26	18.69
Bahrain	11.39	62	4.05	22	2.65	14	0.23	1	18.32
Jordan	7.02	39	2.91	16	4.78	27	3.20	18	17.91
Lebanon	6.76	43	3.19	20	3.97	25	1.89	12	15.81
Region									
MENA	689.61	44	313.98	20	348.94	22	223.50	14	1576.03
Asia (excl. China)	1303.11	50	634.89	25	407.53	16	245.46	9	2590.99
Latin America (excl. Mexico)	262.94	28	238.83	25	324.37	35	111.54	12	937.68
Non-OECD Total	6636.35	50	3294.63	25	1856.69	14	1479.87	11	13267.54
World	12307.24	45	5184.04	19	6337.02	23	3308.06	12	27136.36

Source: IEA database.

Four MENA countries—Egypt, Saudi Arabia, UAE and Iran—rank among the 11 countries worldwide with the fastest increase in emissions (Figure 2.6).

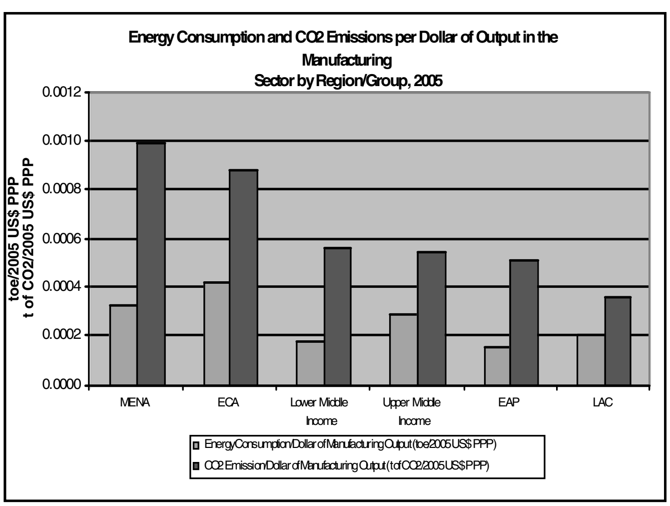
Figure 2.6. 4 MENA countries are among those with highest emissions growth



Source: IEA/OECD, 2006.

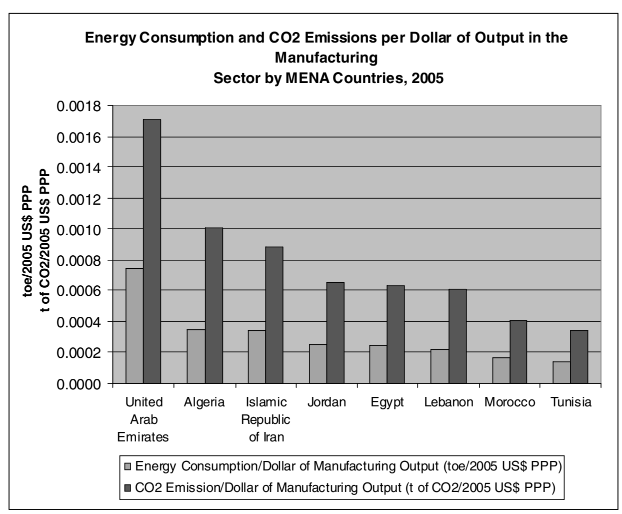
Figures 2.7 and 2.8 illustrate that MENA's manufacturing sector has the highest CO_2 intensity, ahead of ECA. Its emissions are almost twice as high as those of other middle-income countries. Among MENA countries, the UAE has the highest CO_2 intensity per dollar unit of output. In the residential sector, however, MENA has a much lower level of emissions per capita, behind lower-middle-income countries, East Asia, and ECA (Figure 2.9). Within the region, the UAE is again well above other MENA countries, followed by Algeria, Morocco, and Lebanon (Figure 2.10).

Figure 2.7 Manufacturing in MENA is CO_2 intense



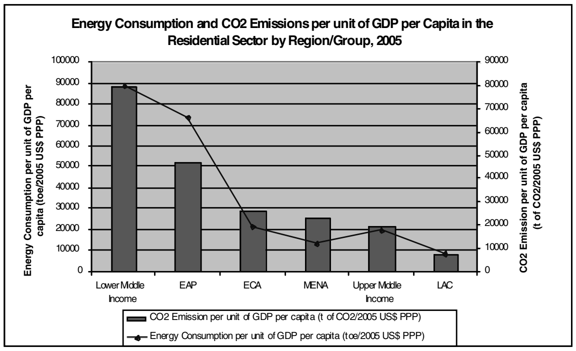
Source: WDI database and IEA/OECD, 2007

Figure 2.8 Wide range of emission-intensity within MENA countries' manufacturing sectors.



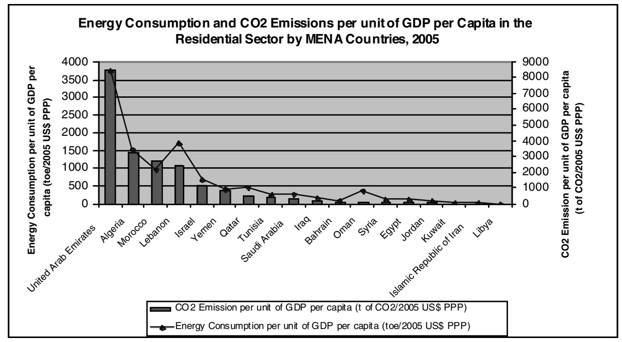
Source: WDI database and IEA/OECD, 2007

Figure 2.9 MENA performs relatively well in residential sector emissions



Source: WDI database and IEA/OECD, 2007

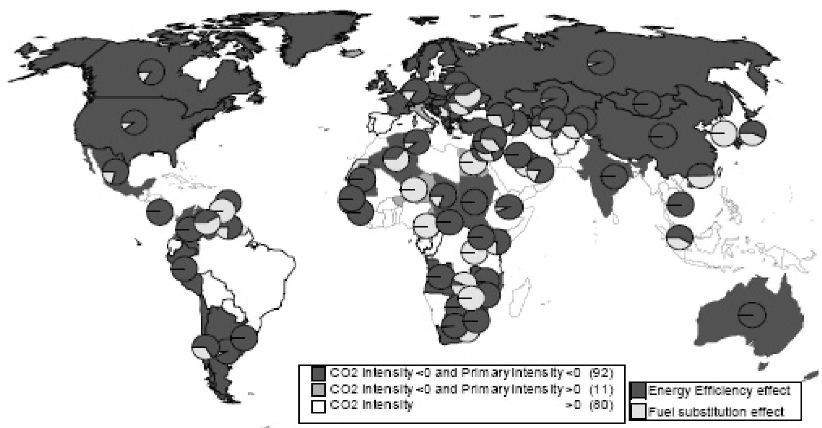
Figure 2.10 Wide range of energy intensities within the region



Source: WDI database and IEA/OECD, 2007

Two factors typically contribute to decreasing the CO_2 intensity of GDP: (1) energy productivity improvements and (2) a switch to energy sources with lower CO_2 emission levels. At the global level, nearly all reduction so far has been due to improved energy productivity; with the exception of China, fuel substitutions have played a minor role to date (Figure 2.11).

Figure 2.6 Impact of fuel substitutions on CO_2 intensity variation, 1990–2005



Source: ENERDATA in WEC, 2008

In order to further understand the factors contributing to changes in CO_2 emissions in MENA countries, a decomposition analysis was conducted for five countries: Egypt, Iran, Jordan, Morocco, and the UAE. For each, the change in emissions between the years 1995 and 2005 was decomposed into five effects:

- *Pollution intensity*, which reflects the pollution levels of different energy sources. If cleaner fuels replace dirtier fuels or if the standards in dirty fuels are upgraded because of changes in environmental regulations, the pollution intensity will decrease and contribute negatively to the increase in CO_2.

- *Energy intensity*, which reflects several factors, including energy efficiency gains in the economy. If industries become more energy efficient (i.e. consume less energy for the same level of output), the energy intensity and the level of CO_2 emissions will fall.
- *Sector structure*, or the composition of an economy, with some sectors (such as manufacturing) being more energy-intensive than others (such as services). If the sector structure of GDP changes in favor of less energy intensive industries, CO_2 emissions are likely to be reduced.
- *Scale*, which reflects changes in GDP per capita; it is expected to grow and thus contribute to additional emissions of CO_2.
- *Population levels;* growth is expected to contribute to higher emission levels.

See chapter appendix 2.2 for a description of the decomposition methodology.

Among the five countries (Table 2.4), Iran had the highest increase in CO_2 emissions between 1995 and 2005, and the highest increase in CO_2 emissions per capita. In spite of significant energy intensity improvements (9.5 percent), it still had the highest CO_2 emissions increase due to an increase in per capita GDP (scale effect). Energy intensity increased in both Egypt and Morocco (10.7 percent and 1.9 percent respectively), but Egypt was moving toward less carbon- intensive sectors (negative structure sector effect). Emissions were declining in the UAE (negative pollution effect), perhaps reflecting the significant reduction in gas-flaring over the period (Figure 2.11).

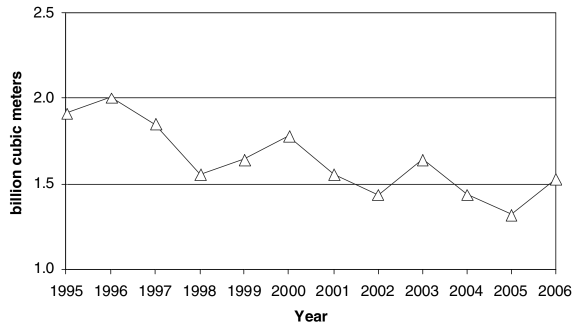
Table 2.4. Decomposition of the Changes in CO_2 Emissions between 1995 and 2005 (Mt of CO_2)

	Pollution Intensity	Energy Intensity	Sector Structure	Scale	Population	Change in CO_2 Emissions	CO_2 Emission per capita (t/capita)		GDP per capita (PPP 2005$US)	
	ΔC_C	ΔC_I	ΔC_S	ΔC_G	ΔC_B	ΔP	2005	2005-1995	2005	2005-1995
Iran	6.4	-9.5	10.4	103.3	47.1	157.8	6.0	1.7	7949	2184
Egypt	8.9	10.7	-5.6	28.2	21.4	63.6	2.0	0.6	4327	959
UAE	-8.4	-15.9	11.8	0.9	54.1	42.6	24.4	-3.8	25472	272
Morocco	1.6	1.9	0.1	7.9	4.5	15.9	1.4	0.4	4544	978
Jordan	0.4	-1.7	0.3	2.9	3.9	5.8	3.3	0.4	5521	971

Source: Zhang, 2008.

It is to be noted that the energy intensity effect in this methodology is residual, and includes the changes in emissions that are not covered by other explanatory variables. So the inclusion or exclusion of variables such as sector structure, or the breakdown of energy use by source, can produce different estimates of the energy intensity effect. More details of the different decompositions are provided in Zhang (2008).

Figure 2.11. U.A.E gas flaring reduced in the period 1995-2006



Note: Estimated from Defense Meteorological Satellite Program Data
Source: Elvidge et al. 2007, in WEC, 2008.

Energy Efficiency for a Better Environment

As seen above, when cleaner energy is substituted for polluting fuels and technologies, when gas releases are captured or when less energy is consumed per unit of output, emissions growth is reduced. So improved energy efficiency (in both supply and use) helps mitigate the local and global environmental impact of energy by reducing both PM pollution and greenhouse gas emissions.

Improvements in energy efficiency can reduce PM concentrations, save lives, and cut the economic cost of air pollution. GMAPS can be used to estimate how energy efficiency would reduce PM_{10} concentrations by lowering energy use, making the reasonable assumption that energy consumption is inversely proportional to energy efficiency, with other factors not changing.

So, using the GMAPS, three energy efficiency scenarios were tested to assess their potential to reduce PM concentrations. Six separate per capita fuel consumption variables were included: coal, oil, natural gas, nuclear, hydroelectric, combustible renewables, and waste. In addition, the model included per capita consumption of gasoline and diesel used in the transportation sector.

The method for estimating the potential to reduce PM concentrations by improving energy efficiency is illustrated in Figure 2.11. The estimated energy consumption coefficients are summarized in Table 2.5. The coefficients are elasticities—the percentage change in *total* PM emissions resulting from a 1 percent increase in a specific variable.

Some fuel types are substitutable (e.g., gasoline and diesel in the transportation sector). Thus, the coefficients capture both a scale effect and a substitution effect. This explains the negative sign in front of the gasoline variable coefficient, which reflects the substitution of gasoline for diesel fuel.

Figure 2.12. The Approach Used to Estimate Change in PM Concentrations by Scenario of Improved Energy Efficiency

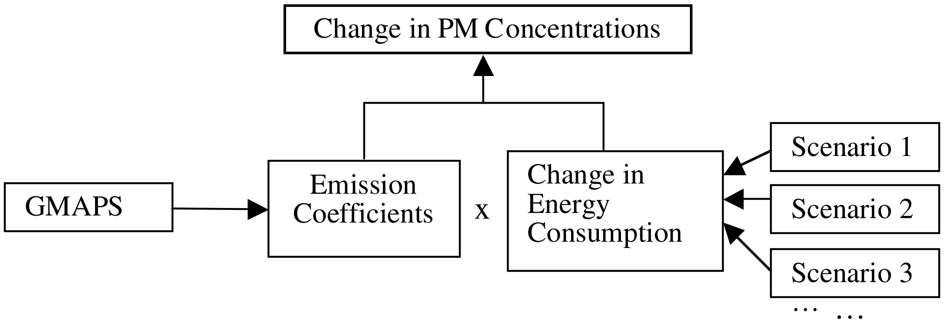


Table 2.5. GMAPS Estimates of PM Concentration Elasticities, with respect to Energy Consumption

In Country Per Capita Consumption	Estimated total PM concentration coefficients
motor gasoline consumption	-0.1408
diesel consumption	0.1123
coal consumption	0.0557
hydro consumption	-0.0850
natural gas consumption	-0.0489
nuclear consumption	-0.0036
combustible and renewable consumption	-0.0654
oil consumption	0.5867

Source: GMAPS model

If a country undertakes an energy efficiency program that reduces per capita oil consumption by 10 percent, it can result in a 5.9 percent reduction in PM concentrations. We know the relationship between PM concentrations and mortality is complex, but assuming a 1:1 correlation between reduction in PM concentrations and premature deaths from air pollution, a 10 percent improvement in energy efficiency could save about 2,400 lives every year in the eight countries listed in Table 2.2.[9] Similarly, if an energy efficiency program is targeted to reduce per capita diesel consumption in the transportation sector by 10 percent, PM concentrations are expected to fall by 1.1 percent. The results for energy efficiency improvements of 10, 20, and 30 percent in each MENA country—translated into reductions of per capita coal, oil, and diesel consumption of 10, 20, and 30 percent—are given in Table 2.6 and Figure 2.13. Iraq has the highest PM concentrations in the baseline, so it achieves the highest reduction in PM concentrations in absolute terms—from 167 μg/m3 to 129 μg/m3—a 23 percent reduction in PM concentrations for a 30 percent energy-efficiency improvement.

Although not a matter of energy efficiency, strictly speaking, the same goes for switching from fossil fuels to non-polluting renewables. So switching 10% of use from fossil to renewable sources would give a 5.9% reduction in PM concentrations and save 2,400 lives a year in 8 MENA countries.

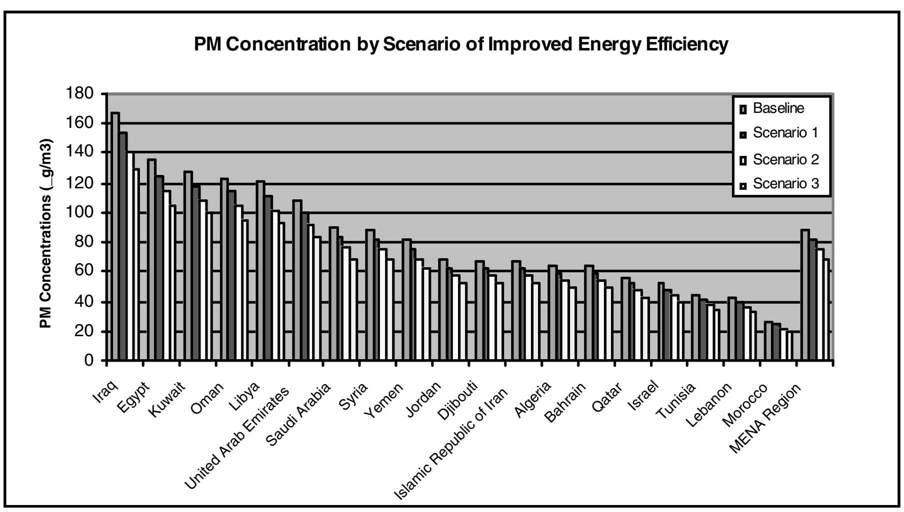
[9] 5.9 percent of the 40,440 premature deaths listed on Table 3.2

Table 2.6. PM Concentrations (µg/m3) by Scenario of Improved Energy Efficiency

MENA Country	Baseline	Scenario 1 10% reduction in per capita coal, oil, and diesel consumption	Scenario 2 20% reduction in per capita coal, oil, and diesel consumption	Scenario 3 30% reduction in per capita coal, oil, and diesel consumption
Iraq	167	154	142	129
Egypt	136	126	115	105
Kuwait	129	119	110	100
Oman	124	115	105	96
Libya	121	112	103	94
United Arab Emirates	109	101	93	84
Saudi Arabia	91	84	77	70
Syria	89	82	76	69
Yemen	82	76	70	63
Jordan	69	64	59	53
Djibouti	68	63	58	53
Islamic Republic of Iran	68	63	58	53
Algeria	65	60	55	50
Bahrain	65	60	55	50
Qatar	57	53	48	44
Israel	53	49	45	41
Tunisia	46	43	39	36
Lebanon	43	40	37	33
Morocco	27	25	23	21
MENA Region	*90*	*83*	*76*	*70*

Source: World Bank calculations using GMAPS model

Figure 2.13. PM Concentrations by Scenario of Improved Energy Efficiency



Source: Table 2.6

Finally, the model demonstrates that the potential for reducing CO_2 emissions by improved energy efficiency is quite significant. Assuming that improvements in energy efficiency deliver a proportional reduction in energy use,[10] energy efficiency gains of 10 percent in the main sectors (including transport, manufacturing, and the category "energy and other sectors") would generate CO_2 reductions of about 158 Mt, equivalent to $2.4 billion[11]. It is observed that the biggest reduction in CO_2 emissions, 5.8 percent of total emissions, would come from a 10 percent energy efficiency improvement in the "energy and other sectors" segment of the economy. A 10 percent improvement in the energy efficiency of the manufacturing sector would result in CO_2 emission reductions in the range of 2.0 percent of total emissions. A comparable 10 percent energy-efficiency improvement in the transportation sector would reduce total CO_2 emissions by 2.2 percent, with Iraq receiving the highest level of reductions (3.5 percent). The summary results are presented in Table 2.7, and the detailed country results are presented in Table 2.8.

Table 2.7. Potential CO_2 Reductions from 10 Percent Energy Efficiency Improvements

	----------------------	CO_2 emissions with	10 % EE Gain----	---------------------
CO_2 Emissions Baseline (Mt)	Transport Mt	Manufacturing Mt	Energy and Other Sectors Mt	All sectors Mt
1,576	1,541 (2.2%)	1,544.62 (2.0%)	1,484.69 (5.8%)	1,419 (10%)

Source:GMAPS model

[10] Referring to Appendix 2, CO_2 emissions can be decomposed as the following.

(1) $$P = \sum_j \frac{P_j}{E_j}\frac{E_j}{Y_j}\frac{Y_j}{Y}\frac{Y}{B}B = \sum_j C_j I_j S_j GB$$

j=1, transportation sector
j=2, manufacturing sector
j=3, energy and other sectors.

The objective is to test how a change in energy intensity (energy efficiency) I_j change would affect the total CO2 emissions *P*, assuming other factors do not change. Equation (2) can be rewritten as

(2) $$P = \sum_j A_j I_j \ ,$$

where $A_j = C_j S_j GB$, a combined factor.

[11] Using a market price of $15/ton CO2.

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Table 2.8. Scenarios of Energy Efficiency Improvements and CO2 Reductions by Sector

A2	A3	Baseline: 2005				Scenario 1: 10% EE improvement in Transportation sector			Scenario 2: 10% EE improvement in Manufacturing sector			Scenario 3: 10% EE improvement in other sectors		
		P	I1	I2	I3	I1_new	P_new	% change of P	I2_new	P_new	% change of P	I3_new	P_new	% change of P
0.04	1.00	84.29	746.35	279.11	55.10	671.72	82.51	2.11	251.20	83.17	1.33	49.59	78.76	6.56
0.01	1.40	18.31	1553.27	428.43	8.28	1397.94	18.05	1.45	385.58	17.91	2.21	7.45	17.15	6.34
0.21	2.01	147.60	498.57	180.16	39.05	448.71	144.44	2.14	162.14	143.86	2.53	35.15	139.74	5.33
0.26	2.44	407.08	521.83	290.13	94.39	469.65	397.05	2.46	261.12	399.44	1.88	84.96	384.05	5.66
0.00	0.80	84.64	1752.77	3709.65	46.68	1577.49	81.68	3.50	3338.69	82.89	2.07	42.01	80.89	4.43
0.16	1.43	59.86	537.82	11.67	33.66	484.04	58.87	1.65	10.51	59.68	0.30	30.30	55.04	8.05
0.01	0.13	17.90	577.23	205.26	77.11	519.51	17.42	2.67	184.73	17.61	1.63	69.40	16.88	5.70
0.01	2.21	74.63	531.45	1507.67	24.49	478.30	73.83	1.08	1356.90	73.39	1.66	22.04	69.21	7.26
0.02	0.38	15.80	621.02	178.80	22.77	558.92	15.40	2.51	160.92	15.48	2.02	20.49	14.94	5.47
0.06	0.32	45.40	1463.20	127.03	81.56	1316.88	44.23	2.58	114.33	44.67	1.61	73.40	42.76	5.81
0.06	0.50	41.34	110.79	124.74	64.33	99.71	41.16	0.44	112.26	40.62	1.73	57.90	38.10	7.83
0.01	1.81	26.98	930.64	380.55	10.10	837.58	26.62	1.34	342.49	26.47	1.89	9.09	25.15	6.77
0.06	0.38	36.37	971.87	151.33	55.07	874.68	35.76	1.69	136.20	35.47	2.49	49.56	34.25	5.83
0.34	2.26	319.68	1554.84	208.33	77.74	1399.36	312.43	2.27	187.50	312.54	2.23	69.97	302.11	5.50
0.03	0.46	47.76	436.03	379.47	57.06	392.43	46.59	2.46	341.52	46.78	2.05	51.36	45.14	5.49
0.04	0.31	19.29	461.98	96.62	35.13	415.78	18.84	2.35	86.96	18.90	2.00	31.62	18.20	5.65
0.04	4.02	110.38	1136.47	707.10	14.14	1022.82	108.17	2.00	636.39	107.23	2.86	12.73	104.70	5.15
0.01	0.23	18.69	442.93	257.63	46.57	398.64	18.07	3.31	231.87	18.51	0.98	41.91	17.62	5.71

Source: World Bank calculations from GMAPS model

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Appendix 2.1: The GMAPS

The GMAPS econometrically estimates a fixed-effect model of the concentrations of urban ambient PM using the latest available data from a sample of cities from the World Health Organization (WHO) and other sources, and then uses regression estimates to predict PM concentrations worldwide.

The primary determinants of the GMAPS include the scale and composition of economic activity, the energy mix, the strength of local pollution regulations, and geographic and atmospheric conditions that affect the transport of pollutants. The GMAPS is a log-log linear model. The dependent variable is log [PM10] and the independent variables are the log form of the following variables plus time-tend variables:

- Energy consumption,
- Meteorological and geographic factors,
- City and national population and national population density,
- Local population density,
- Local intensity of economic activity, and
- National income per capita.

The GMAPS model is designed to obtain the best city-level prediction of concentrations of PM for a wide range of cities on the basis of limited data. Subregion PM concentrations are computed from estimates of concentrations of PM10 in the cities, using the populations of each city as weights.

In terms of the cost of PM emissions, the *2006 Little Green Data Book* (World Bank, 2006) uses a percentage of 2004 gross national income (GNI) for each country to provide an order of magnitude. It is also useful to compare the cost of air pollution to GNI to assess the relative magnitude over time.

The process of estimating the cost of air pollution involves placing a monetary value on the consequences of air pollution. A three-step process is usually used. Step (1) is to translate PM levels to health effects—mortality and morbidity by age/sex for each country. The concentration-response relationships are the same for all countries. These define the percentage increase in health effects for each unit increase in PM levels. The concentration-response functions vary by the age of a person. As a result, the health effects for a country depend on population characteristics (age structure) and baseline health characteristics. This step is outlined in Cohen et al. (2004). Step (2) is to translate health effects to economic costs. The lost lives and morbidity effects are translated to Disability-Adjusted Life Years (DALYs). Since DALYS are age/sex dependent, demographic characteristics are important in this step. Finally, Step (3) is to translate DALYS to monetary costs. This requires valuation of a statistical life and is assumed to vary in proportion to GNI.

Appendix 2.2: Decomposition Analysis – Theoretical Model

Fossil fuel–related CO_2 emissions in a given year—decomposed into individual components—can be written as:

(1) $$P = \sum_j \frac{P_j}{E_j}\frac{E_j}{Y_j}\frac{Y_j}{Y}\frac{Y}{B}B = \sum_j C_j I_j S_j GB$$

P = the amount of CO_2 emissions from the consumption of fossil fuels

E = the amount of fossil fuel consumption

Y = GDP

B = population

j = sector

$C_j \equiv \dfrac{P_j}{E_j}$ shows pollution intensity in sector *j*.

$I_j \equiv \dfrac{E_j}{Y_j}$ shows energy intensity in sector *j*.

$S_j \equiv \dfrac{Y_j}{Y}$ shows sector structure of the economy.

$G \equiv \dfrac{Y}{B}$ shows GDP per capita

The change in a country's emission (ΔP) from period *0* to period *T* can be decomposed into (1) pollution intensity effect (ΔC_C), (2) energy intensity effect (ΔC_I), (3) sector structure effect (ΔC_S), (4) scale effect (ΔC_G), and (5) population effect (ΔC_B).

(2) $$\Delta P = P^T - P^0 = \Delta C_C + \Delta C_M + \Delta C_I + \Delta C_S + \Delta C_G + \Delta C_B$$

Using the logarithmic mean Divisia Index (LMDI) formulae developed by Ang (2005), these effects can be calculated as follows.

(3) $$\Delta C_C = \sum_j \frac{P_j^T - P_j^0}{\ln P_j^T - \ln P_j^0}\ln\left(\frac{C_j^T}{C_j^0}\right)$$

$$(4)\quad \Delta C_I = \sum_j \frac{P_j^T - P_j^0}{\ln P_j^T - \ln P_j^0} \ln\left(\frac{I_j^T}{I_j^0}\right)$$

$$(5)\quad \Delta C_S = \sum_j \frac{P_j^T - P_j^0}{\ln P_j^T - \ln P_j^0} \ln\left(\frac{S_j^T}{S_j^0}\right)$$

$$(6)\quad \Delta C_G = \sum_j \frac{P_j^T - P_j^0}{\ln P_j^T - \ln P_j^0} \ln\left(\frac{G^T}{G^0}\right)$$

$$(7)\quad \Delta C_B = \sum_j \frac{P_j^T - P_j^0}{\ln P_j^T - \ln P_j^0} \ln\left(\frac{B^T}{B^0}\right)$$

The change in emissions will reflect changes in the five effects because of the nature of the identity in equation (2). The pollution intensity effect reflects energy mix in terms of polluting levels. If more clean fuels are replacing dirty fuels or dirty fuels are less dirty due to strengthened environment policies, the pollution intensity will decrease and negatively contribute to the increase of CO_2 emissions from period *0* to period *T*. The energy intensity effect reflects several factors including the energy efficiency of the economy. If industries adopt higher energy efficiency standards (with less energy required to produce the same output), energy intensity will fall. With proper policies, this effect could also reduce CO_2 emissions. The sector structure effect reflects an economy's composition. Some sectors are more energy intensive than others—e.g., the manufacturing sector is more energy intensive than most service sectors. If the sector structure of GDP changes toward sectors that are less energy intensive, the average use of energy as a factor of total GDP will fall, and so will total CO_2 emissions. The scale and population effects show how GDP per capita, and population levels, changed over the period. We generally expect populations to grow over time and people to become wealthier. These two effects generally contribute to the increase of CO_2 emissions, unless there are price or regulatory incentives to change behaviors toward less energy-intensive consumption patterns.

Data and Application

The decomposition analysis was conducted using data from the period 1995–2005. The major challenge of the estimation is that there are no consistent data sources for the classification of economic sectors. Owing to the time and data constraints, the economy was structured into three sectors: transport, manufacturing, and energy and related sectors. The data sources and data adjustment are explained as follows.

The emission of CO_2 by sector P_j

IEA has CO_2 emission data measured in million tons (Mt) of CO_2 by fossil fuel type and by sector. Fossil fuel types include coal and coal products, oil, and natural gas. The sectors are classified as:

- Energy sector
- Main activity producer electricity and heat

- Unallocated autoproducers[12] [[au: please define "autoproducer"—ed.]]
- Other energy industries
- Manufacturing industries and construction
- Transport
- Other sectors

In order to match the three sectors proposed above, the energy sector was aggregated with other sectors.

Fossil fuel consumption by sector E_j

IEA has energy balance data that include energy consumption measured in thousand tons of oil equivalent (ktoe) by fuel type and by sector. The total final consumption by sector includes industry sector, transportation sector, other sectors, and non-energy use. Other sectors and non-energy use were aggregated and the industry sector was treated as the manufacturing sector in the classification.

The level of GDP *Y*

The GDP data in 1995 and 2005 are taken from the IEA database and measured in constant 2000 US$ and valued according to the purchasing power parity (PPP); 2000 US$ were extrapolated into 2005 US$ by using the GDP deflator published by the US government. Thus, all GDP data are measured in billions of 2005 US$ PPP. A first iteration attempted to use the GDP data in 2005 taken from the *2005 International Comparison Program (ICP) Preliminary Results* report published in December 2007 (World Bank, 2007b), which used an updated method to estimate PPPs. The results, however, showed that the new GDP 2005 data represent a new benchmark and are not comparable with previous results, and gave unexpected growth rates for certain countries.

The level of GDP by sector Y_j

The UN national accounts database in the Development Data Platform (DDP) lists the categories of manufacturing (percentage of GDP) and transport and communications (current US$). Although the database has a separate row for transport value-added, the relevant data are, unfortunately, missing for nearly all MENA countries. Thus, the transport and communications category was used as a proxy for the transport sector. Such a proxy has its limitations because this category includes postal services and telecommunications, which is a low-carbon intensity sector. Therefore, it was not possible to estimate the effect of changes in the carbon-intensity of the transport sector over time because the rapid growth of the low-carbon telecommunications sector would have biased (downward) the carbon intensity growth of the transport and communications sectors. But this proxy should not affect the validity of the decomposition analysis regarding the sector share effect because the growth decomposition is an identity. In addition, the assumption that communication is zero carbon is necessary to map IEA energy data onto DDP value-

[12] "Autoproducer undertakings generate electricity and/or heat, wholly or partly for their own use as an activity which supportstheir primary activity. They may be privately or publicly owned." See: http://www.iea.org/Textbase/work/2004/eswg/08_Public_Auto_P%20L%F6s%F6nen.pdf

added data. Furthermore, to ensure the consistency of the energy intensity effect, it was further assumed that the private and commercial transport subsectors have grown at the same rates. Finally, the level of GDP by sector was adjusted to constant 2005 US$ PPP in billions.

The population of the country *B*

Data on population is taken from the IEA database and measured in millions.

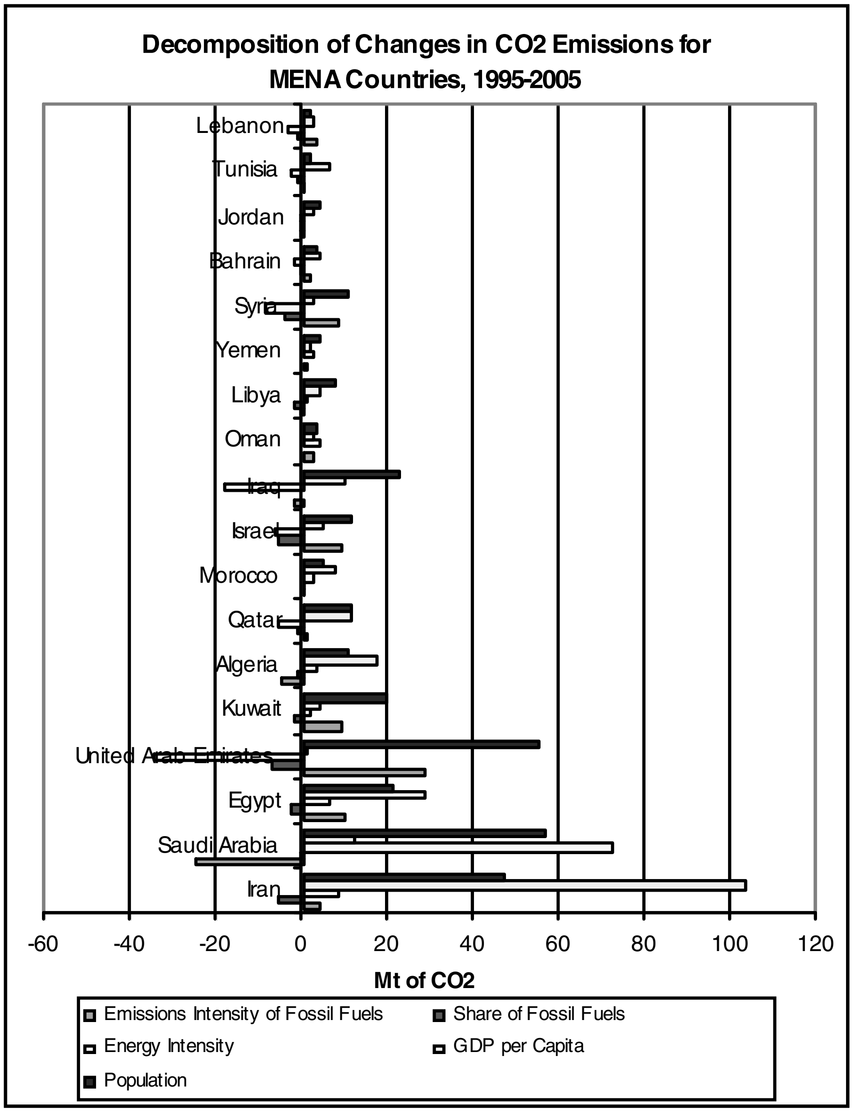
Alternative Decomposition Method

For the sake of comparison, the decomposition method used in the recent World Bank report *Growth and CO_2 Emissions: How Do Different Countries Fare* (World Bank, 2007a) was applied for MENA countries to analyze the CO_2 emissions change between 1995 and 2005. The major difference between this decomposition method and the method used above is that it does not consider sector structures but includes the share of fossil fuels in total energy (the substitution effect). For ease of comparison, the same notations were used here as in the report. Results are presented in table 1 and figure 1.

Table 1. Decomposition of the change in CO_2 Emissions between 1995 and 2005 (Mt of CO_2), alternative method

Country	Coefficient Effect	Substitution Effect	Energy Intensity Effect	GDP per Capita	Population	Change of CO2 Emissions	CO2 Emission per Capita (t of CO2 per capita)		GDP per capita (PPP 2005$ US)	
	Ceff	Seff	Ieff	Geff	Peff	ΔE	2005	2005-1995	2005	2005-1995
Iran	3.8	-5.3	8.7	103.4	47.1	157.8	6.0	1.7	7949	2184
Saudi Arabia	-24.7	-0.2	72.7	12.4	57.1	117.2	13.8	2.9	15673	736
Egypt	9.8	-2.4	6.5	28.3	21.4	63.6	2.0	0.6	4327	959
United Arab Emirates	28.4	-7.4	-34.6	0.9	55.1	42.6	24.4	-3.8	25472	272
Kuwait	9.3	-1.6	1.8	4.2	19.4	33.2	29.4	6.4	26211	1877
Algeria	-5.2	-1.2	3.4	17.4	10.7	25.0	2.6	0.5	7046	1529
Qatar	1.1	-0.9	-5.4	11.2	11.4	17.3	44.7	8.5	43235	14756
Morocco	0.6	0.4	2.5	7.9	4.5	15.9	1.4	0.4	4544	978
Israel	9.2	-5.6	-6.7	5.1	11.7	13.5	8.7	0.3	25816	2380
Iraq	-1.7	0.1	-17.9	10.0	22.4	12.9	2.9	-0.4	1016	121
Oman	2.5	0.0	3.9	2.9	3.3	12.6	10.5	3.9	15503	2093
Libya	-0.4	-2.2	1.2	3.9	7.8	10.3	7.8	0.5	7884	736
Yemen	0.9	0.0	2.6	1.5	4.3	9.4	0.9	0.3	928	98
Syria	8.7	-4.2	-8.5	2.2	11.0	9.1	2.5	-0.1	3799	194
Bahrain	2.0	-0.6	-2.0	4.0	3.4	6.7	25.2	5.3	21337	5000
Jordan	-0.3	-0.3	-0.4	2.9	3.9	5.8	3.3	0.4	5521	971
Tunisia	0.5	-0.8	-2.9	6.3	1.9	5.0	1.9	0.3	8350	2635
Lebanon	3.4	-1.4	-3.1	2.6	1.7	3.2	4.4	0.5	5566	950

Source: World Bank calculations from GMAPS model



Source: Table 1

Table 2 compares the 1994–2004 CO_2 decomposition from the World Bank report (World Bank, 2007a) and the 1995–2005 CO_2 decomposition using the same method. Since the two periods have significant overlaps, the results are relatively comparable, especially for GDP per capita and population effects.

Table 2. Comparison of the 1994-2004 CO_2 decomposition and the 1995–2005 CO_2 decomposition

Country	Period	Coefficient Effect	Substitution Effect	Energy Intensity Effect	GDP per Capita	Population	Change of CO_2 Emissions
		Ceff	Seff	Ieff	Geff	Peff	ΔE
Algeria	1994-2004	-6.7	-0.3	-30.4	18.2	12.4	-6.9
Algeria	1995-2005	-5.2	-1.2	3.4	17.4	10.7	25.0
Bahrain	1994-2004	-0.3	0.0	-1.7	4.4	4.5	7.0
Bahrain	1995-2005	2.0	-0.6	-2.0	4.0	3.4	6.7
Egypt	1994-2004	-11.4	2.6	5.8	29.8	22.9	49.7
Egypt	1995-2005	9.8	-2.4	6.5	28.3	21.4	63.6
Iran	1994-2004	-27.3	1.3	35.2	107.5	36.6	153.1
Iran	1995-2005	3.8	-5.3	8.7	103.4	47.1	157.8
Israel	1994-2004	-1.6	0.2	0.7	5.3	13.5	18.1
Israel	1995-2005	9.2	-5.6	-6.7	5.1	11.7	13.5
Morocco	1994-2004	-0.9	-0.9	-4.6	3.9	4.4	1.9
Morocco	1995-2005	0.6	0.4	2.5	7.9	4.5	15.9
Oman	1994-2004	-0.3	0.0	2.0	3.1	3.4	8.3
Oman	1995-2005	2.5	0.0	3.9	2.9	3.3	12.6
Saudi Arabia	1994-2004	-6.6	0.0	70.9	-18.7	81.2	126.8
Saudi Arabia	1995-2005	-24.7	-0.2	72.7	12.4	57.1	117.2
Syria	1994-2004	-1.2	0.7	-2.3	2.6	12.0	11.9
Syria	1995-2005	8.7	-4.2	-8.5	2.2	11.0	9.1
Tunisia	1994-2004	-1.3	-0.1	-2.5	6.4	2.2	4.9
Tunisia	1995-2005	0.5	-0.8	-2.9	6.3	1.9	5.0
United Arab Emirates	1994-2004	-4.6	0.0	-21.6	2.0	71.7	47.4
United Arab Emirates	1995-2005	28.4	-7.4	-34.6	0.9	55.1	42.6

Table 3 compares the results of two different decomposition methods for the five MENA countries. Decomposition method 1 includes sector structure; method 2 includes fossil fuels in total energy levels. As expected, both methods provide the same scale effects and population effects. In terms of energy intensity, method 1 defines it as *fossil fuel* consumption per unit of GDP, while method 2 defines it as the *total* energy consumption per unit of GDP. Taking Iran as an example, energy intensity is negative using method 1, which means that less fossil fuel is required per unit of GDP (thus negatively contributing to the CO_2 increase). Sector structure effect is positive, however, which means that the economy switches to more CO_2-intensive sectors, and thus contributes to a CO_2 increase. Using method 2, Iran has a positive energy intensity effect and a negative substitution effect, which mean that total energy use per unit of GDP increases and thus contributes to the CO_2 increase; but among the total energy use, the share of fossil fuel use decreases and negatively contributes to the CO_2 increase. Therefore, different decomposition methods provide different perspectives on what factors contribute to changes in CO_2 emissions.

Table 3. Two decomposition methods: comparison of results

	Decomposition Method	Pollution Intensity/ Coefficient Effect	Energy Intensity	Sector Structure/ Substitution Effect	Scale	Population	Change of CO2 Emissions
Iran	1	6.4	-9.5	10.4	103.3	47.1	157.8
Iran	2	3.8	8.7	-5.3	103.4	47.1	157.8
Egypt	1	8.9	10.7	-5.6	28.2	21.4	63.6
Egypt	2	9.8	6.5	-2.4	28.3	21.4	63.6
United Arab Emirates	1	-8.4	-15.9	11.8	0.9	54.1	42.6
United Arab Emirates	2	28.4	-34.6	-7.4	0.9	55.1	42.6
Morocco	1	1.6	1.9	0.1	7.9	4.5	15.9
Morocco	2	0.6	2.5	0.4	7.9	4.5	15.9
Jordan	1	0.4	-1.7	0.3	2.9	3.9	5.8
Jordan	2	-0.3	-0.4	-0.3	2.9	3.9	5.8

Chapter 3: Energy Subsidies, Energy Efficiency, and Fiscal Balance

Energy subsidies and energy efficiency have a two-way relationship. On the one hand, energy subsidies encourage the inefficient use of energy. On the other hand, greater energy efficiency reduces the cost of energy subsidies—for the simple reason that less energy is used.

Energy subsidies are a major reason for the high level of energy consumption in MENA. The region has a strong tradition of underpricing energy, and subsidies constitute a significant share of governments' expenditures. In Yemen, for example, energy subsidies represented more than 30 percent of all government spending for the period 2005-2008 (World Bank, 2008d). Petroleum subsidies alone were estimated to amount to 11 percent of GDP (US$3 billion) in 2008 (World Bank, 2008c).

This chapter compares subsidy practices in MENA with those in other world regions. It also discusses the effects of energy subsidies on both GDP and fiscal balances. Finally, it looks into how greater energy efficiency could strengthen governments' fiscal balances. The subject of how energy subsidies discourage energy efficiency is dealt with in chapter 4.

This section addresses five energy subsidy issues: how to measure subsidies, the size of energy subsidies, where subsidies are applied, how subsidies are transferred, and who benefits.

Energy markets are moving rapidly, and prices and costs change all the time. So, this chapter focuses more on economic relationships than on precise numbers. Even if actual numbers will be somewhat different at the time of publication, the key conclusions about prices, costs, and subsidies, however, will remain valid for the MENA region.

Box 3.1. Energy subsidies in Egypt

Energy subsidies play an important role in Egypt's political economy. Energy subsidies reached about 42 billion Egyptian pounds (LE) in 2005/06, or about US$8.5 billion. The largest shares of the total were for gasoline (39 percent), liquefied propane gas (21 percent), natural gas (14 percent), electricity (16 percent), and diesel (14 percent). By sector, the largest share of subsidies, 43 percent, went to the transport sector (LE 18 billion).

In 2005/06, energy subsidies represented close to 10 percent of Egypt's GDP and about 30 percent of public expenditures—five times public spending on health and seven times public spending on education. In March 2008, the Government of Egypt announced that an additional LE 19 billion over the budgeted amount would be required for energy subsidies in 2007/08 because of rising oil prices; by June 2008, fuel subsidies were expected to cost LE 57 billion (about US$10.7 billion).

For the past several years, the government has been working on a plan to phase out energy subsidies while protecting vulnerable consumers. Price adjustments began in 2004, when electricity tariffs were increased for the first time since 1992.

In May 2008, the Government took a number of measures. It sequentially announced a 30 percent increase in civil servants' salaries, then an increase in several energy prices, including a 30–40 percent increase in the price of high-octane gasoline; a 58 percent increase in natural gas for heavy industry; a 46 percent increase for kerosene and diesel. To generate fiscal revenues to offset energy subsidies to the transport sector, the Government also increased vehicle license fees from a flat fee of LE 500 to 2 percent of the value of the vehicle. These measures are designed to finance the increase in the public payroll, estimated at LE 12.5 billion annually, and to reduce the LE 111 ($21) monthly subsidy to vehicles consuming less than 100 liters a month.

The energy price increases increased social tensions, among fears that the poor would be most affected and that inflation would grow beyond the 14.4 percent mark recorded in March 2008.

Source*:* World Bank 2008a, Madbouli 2008 and Oxford Business Group 2008

How are Energy Subsidies Measured?

Energy subsidies can be divided into explicit (on-budget) and implicit (off-budget) subsidies. Total subsidies within a country are the sum of on- and off-budget components.

Explicit, or on-budget, subsidies are budgeted financial transfers, mostly to national energy or refining companies. They reimburse the energy company for the difference between the wholesale domestic price and the economic cost of procuring fuel or producing electricity. Explicit subsidies are relatively easy to estimate, so long as budgetary data are available.

Most explicit energy subsidies in MENA simply finance general price reductions. This encourages inefficient energy use. Sometimes, however, governments use so-called smart subsidies, for example, to encourage market penetration of renewable energy technologies. Such subsidies can be economically efficient, because they help overcome barriers to technological innovation.

Implicit or off-budget subsidies are also transfers from the public sector to the energy user, but not through the Government budget. They might occur when profits from one class of customer, for example industrial companies, are used to cross-subsidize another. Other examples are state guarantees provided without charge on behalf of state-owned enterprises; such guarantees create contingent liabilities that are not conventionally counted as a fiscal cost unless they are invoked. A third example is domestically produced energy sold at below market prices.

Although implicit subsidies are harder to estimate than explicit subsidies, they can be estimated by subtracting explicit subsidies from total subsidies. To calculate total subsidies, however, one needs to estimate a benchmark price: the likely price of energy in the absence of government intervention. Subsidies are then the gap that governments create between actual domestic energy prices and the benchmark price.

- The benchmark price for *internationally traded fuels* is relatively simple to estimate. For energy-importing countries, it is the c.i.f. import price plus a margin for domestic transport. This is what domestic energy users would have to pay for imported energy in the absence of government intervention. For energy-exporting countries, the benchmark price is the f.o.b. export price.

- For *gas*, there is no integrated international market to provide a global benchmark price. However, with price data from the growing Liquid Natural Gas market, and knowing that gas can substitute for liquid petroleum fuels in power generation, it is possible to establish a benchmark ("netback") price.

- For *electricity*, one possible approach is to compare the domestic price with prices in other countries that do not have subsidies. The difference can be taken as the effect of the subsidy. This methodology has at least two major difficulties, however. First, the two electricity sectors being compared may have very different production costs, especially if one uses locally produced gas. Second, many countries have a wide range of electricity prices, according to the type of users, voltage, time of day, and other factors. This raises the question of which price to use for comparison.

Which kind of subsidy one measures depends on the effect one desires to study. All subsidies make energy cheaper relative to other things, and thus distort energy users' decisions. But different kinds of subsidies affect the government budget and the net financial position of the public sector in different ways (table 3.1).

Table 3.1. Different types of subsidies have different effects

	Affects government budget	Affects net financial position of public sector	Encourages inefficient energy decisions
Explicit: on-budget transfers, usually to a utility			
General energy price reductions	X	X	X
Smart incentives for innovative practices	X	X	
Implicit: off budget transfers			
Cross-subsidy within public sector	X		X
Forgone profits of energy utility/parastatal	X	X	X
Long-term loans, and guarantees, from public sector entities to energy sector	X	X	X

Source: World Bank staff

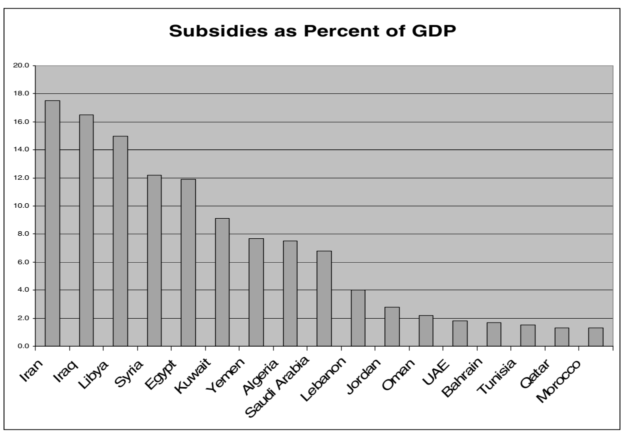
The political economy of explicit and implicit subsidies is quite different. Since on-budget subsidies will be visible to all, the tradeoffs with alternative uses of the same resources are more apparent to the public. So the case for subsidy-removal is easier to explain politically.

How Large are Subsidies?

Expressed as a percentage of GDP, average total energy subsidies amounted to at least 7.1 percent of the GDP of the MENA region in 2006, ranging from 1.3 percent of GDP for Morocco, and 17.5 percent for Iran (figure 3.1). These increased significantly in 2007/2008.

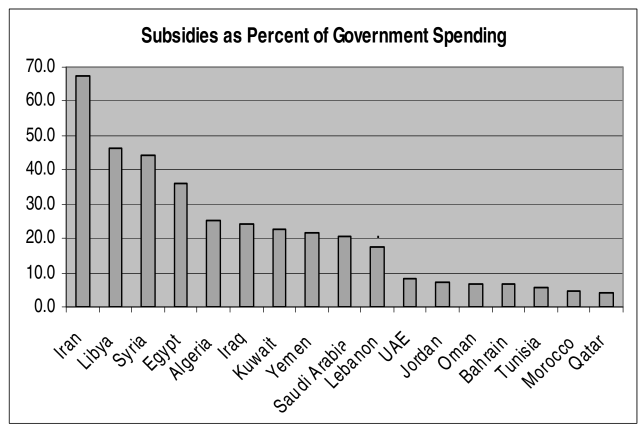
Expressed as a proportion of government spending, energy subsidies, on average, exceeded 20 percent in 2006, ranging from around 4% in Qatar and Morocco to over 40 percent in Syria and Libya and as much as 67 percent in Iraq (figure 3.2)..

Figure 3.1. Energy subsidies* as a percentage of GDP in MENA countries, 2006



Source: Carey, 2008. See appendix 3.1.

Figure 3.2. Energy subsidies* as a percentage of government spending in MENA countries, 2006



* Includes both on- and off-budget subsidies
Source: Carey 2008. See appendix 3.1

Increases in world oil prices raise subsidy levels unless they are passed through to domestic prices. Forty-two developing countries surveyed by the International Monetary Fund (Mati, 2008) responded to the 2007 oil price increase with an increase in explicit subsidies representing 1.5 percent of their total GDP, as well as an increase in implicit subsidies representing 4 percent of their total GDP. In net oil-importing countries the pass-through ratio was much higher (1.15 in 2007) than in net oil-exporting countries (0.58 in 2007).

In passing energy price rises through to consumers, MENA countries lag considerably behind other regions. In a sample of 14 developing and emerging market economies, the explicit subsidy increase averaged 1.5 percent of GDP but reached 9.3 percent of GDP (Yemen). By the end of 2007, the Middle East (table 3.2) was the world region with the lowest price pass-through rate.

Table 3.2. Oil price increase pass-through ratios, 2003–07

Limited pass-through

Fewer than half the countries in the sample fully passed through the surge in world oil prices to retail customers in 2007.

	Gasoline		Kerosene	Diesel
	2006	**2007[1]**	**2007[1]**	**2007[1]**
Net oil importers (average)	1.81	1.15	0.91	1.13
Net oil exporters (average)	0.87	0.58	0.68	0.61
Whole sample (average)	1.59	1.01	0.86	1.01
Net oil importers (median)	1.83	1.03	0.90	1.05
Net oil exporters (median)	0.59	0.53	0.22	0.53
Whole sample (median)	1.72	0.90	0.85	0.88
Africa (median)	1.67	1.06	1.09	1.36
Asia (median)	2.15	1.36	0.65	0.94
Europe (median)	1.75	1.30	...	1.61
Middle East (median)	0.78	0.58	0.34	0.67
Western Hemisphere (median)	1.09	0.70	1.15	0.69
Memo items:				
Countries in sample	42	42	24	37
Countries with full pass-through[2]	31	18	11	17
Within-year pass-through[3]	1.27	0.41	0.63	0.48
Countries with full within-year pass-through[2]	26	8	5	9
International fuel price increase (percent)[3]	6.9	48.1	44.2	47.2

Source: IMF staff.
Note: Unless otherwise indicated, 2003 is used as the reference year for all pass-through calculations.
[1]Post-tax retail prices; latest observation for 2007.
[2]Pass-through is defined as "full" when it is greater or equal to 1.
[3]Calculated using the end of the previous year as the reference point.

Source: Mati, 2008.

Box 3.2. How are Energy Subsidies Quantified?

Quantifying energy subsidies poses significant challenges. First, there is the question of what the "shadow" price of the relevant energy product should be. Studies usually adopt a global benchmark border price as the benchmark; e.g., the price of regular or high-octane gasoline at a major port. Such a benchmark is transparent, but its application assumes that the shadow price would involve no taxation. In fact, given well-documented side-effects from energy use (such as congestion and pollution), the benchmark price may well involve taxation and will thus be understated in the landed price.

For example, the European Union's Energy Tax Directive (2003/96/EC) requires that member states impose motor fuel taxes of at least €0.359 per liter on unleaded gasoline and €0.302 on diesel, which, when taken in conjunction with the value-added tax, represent significant components of retail fuel prices in the EU.[13] Some countries in MENA (e.g., Lebanon) have tried to protect consumers from the impact of higher energy prices by cutting taxes on energy products, with adverse effects on tax revenue. Nevertheless, given the difficulty of determining a socially optimal level of taxation for energy products in MENA, the benchmark fuel price used here is an untaxed port price. Note that this price also excludes distribution margins.

A second challenge is presented by the different types of energy subsidies that may be in place in different countries and their varying modes of implementation. Key subsidies are applied to (1) transportation fuel,

[13] See http://ec.europa.eu/taxation_customs/taxation/excise_duties/energy_products/index_en.htm

(2) residential utilities such as electricity, water, and heat, (3) low-price feedstock or energy inputs for industrial users, and (4) stand-alone energy products such as gas canisters, fuel for lanterns and fires, and so on. While transport fuel subsidies are often implicit (and applied by setting official prices below the would-be market price and requiring distributors to bear the immediate cost), there has been a tendency to move these costs on-budget in recent years. But most oil-producing countries have left these as implicit subsidies.

Subsidies to utilities are also increasingly on-budget, not least because the utilities in MENA tend to be publicly owned and have needed budget allocations when their tariffs have not been able to adjust to global energy prices. But many aspects of the cost structure in electricity generation and distribution are opaque, and subsidies for fuel used by the industry only capture part of that structure. Costs will also depend on the efficiency of power stations and the electrical grid, the financing of investment in the sector, and the mix of fuel sources, among other factors.

Major subsidies to industrial users in MENA are implicit, especially those for the power sector. This is also the case for those relating to the provision of natural gas.

Unlike oil, gas lacks a recognized global price, since the cost of transportation is very high. So subsidy estimates require an assumption about the usable energy content of gas (e.g., in Btu per cubic foot) along with the selection of a price, which by necessity will be location-specific.

Corresponding to the range of subsidies and modes of implementation, estimates of the size of subsidies use different methodologies. The most detailed estimates are those based on sector studies examining actual prices and quantities consumed relative to a benchmark scenario with unsubsidized prices and associated quantities. A more common calculation is to quantify the subsidy as the price wedge between some average actual domestic price and a border price multiplied by actual consumption. Even this calculation can be difficult when data on energy consumption is lacking.

Energy subsidies take on different forms in different countries. To explore the pattern of subsidies, it is helpful to divide countries into groups: high-subsidy countries, countries in the Gulf Cooperation Council (GCC), and low-subsidy countries.

The group of high-subsidy countries consists of Egypt, Iraq, Kuwait, Lebanon, and Yemen. The underlying circumstances are quite different in each case.

- Egypt is a complex case with large on- and off-budget subsidies, respectively 6.9 percent and 5.0 percent of GDP. As a country with a large population and high subsidy rates, the total cost of subsidies is substantial. All energy products are priced below comparable international levels. Determining the economic cost of subsidies is complicated, because Egypt can produce some, but not all, of its domestic energy needs.[14]
- Iraq has a low-cost fuel pricing strategy typical of an oil-producing country, with the complication that the country's refining and distribution capacity has been so degraded that the government is financing imports of refined products. However, Iraq is working to eliminate most of its explicit fuel subsidies, which will make it unusual among oil-producing countries anywhere.[15] Nevertheless, a large implicit subsidy is likely to remain in the form of access of domestic refineries to crude oil at a fraction of the export price.
- Kuwait, with on-budget subsidies of 6.0 percent of GDP and off-budget subsidies of 3.1 percent, is discussed further in the context of GCC countries below.

[14] Egypt imports diesel and butane; oil imports were about $4 billion in 2006/07.
[15] Implicit subsidies on domestically produced products (mainly regular gasoline and diesel) will remain. Imports can be sold at market prices.

- Lebanon's dominant subsidy is to the national electric utility (EdL), mostly to finance the gap between its oil import costs and electricity tariffs, which are based on an oil price of $25 a barrel.
- At present Yemen can meet most of its energy needs from domestic oil production and has a large subsidy carried on-budget. Although oil reserves are limited, high oil prices have helped maintain the increasingly costly subsidies, even as the long-term fiscal path is unsustainable.

Within the GCC, the ratio of energy production to population explains many of the differences in subsidy rates. This can be illustrated by comparing Saudi Arabia's subsidies to those of other GCC countries. The energy endowment of the smaller GCC states is so large relative to their population and energy use that pricing distortions can be accommodated as a small share of GDP (1–3 percent of GDP); in addition, the gap between regulated and border prices for fuel in Oman and the UAE is relatively small. But Saudi Arabia's large population means that the cost of a similar subsidy regime is much larger (6.8 percent of GDP). The outlier in this group of countries is Kuwait, where total energy subsidies are around 9 percent of GDP. This reflects the pervasive nature of subsidies, especially those for electricity and water, which are large even by GCC standards. The relatively low subsidy estimates for Bahrain and Qatar partly reflect the small-country phenomenon discussed above, and partly the fact that major implicit subsidies could not be quantified. Qatar's most significant resource is (nonassociated[16]) natural gas, which lacks a clear benchmark price to which actual transactions could be compared.

The final group of countries maintains subsidies that are modest by regional standards. Prior to the 2008 reforms, Jordan subsidies came to about 3 percent of GDP; in Morocco and Tunisia to less than 2 percent. These subsidies are on-budget and are matched by corresponding fiscal deficits. The fiscal pressure that they exert is therefore immediate, despite their comparatively small size. Morocco limits their scope by targeting products used by low-income households (such as butane). Tunisia has restrained the impact of subsidies on the budget through a prudent energy-price assumption and the continuation of gradual increases in the consumer price of energy. In addition, both countries have low energy intensity by the standards of the region.

The Maghreb is a mixed picture. Energy subsidies are high in the hydrocarbon-exporting countries, Algeria and Libya, and low in the importers, Morocco and Tunisia. Long borders between high- and low-subsidy countries provide opportunities for fuel smuggling. Fuel smuggling from Algeria to Tunisia, for example, was rife in the 1990s, and the subsequent rise in world fuel prices has now raised the rewards. The owner of four-wheel-drive truck can turn a net profit of $1,000 per month smuggling fuel from Algeria to Niger (Tran, 2008).

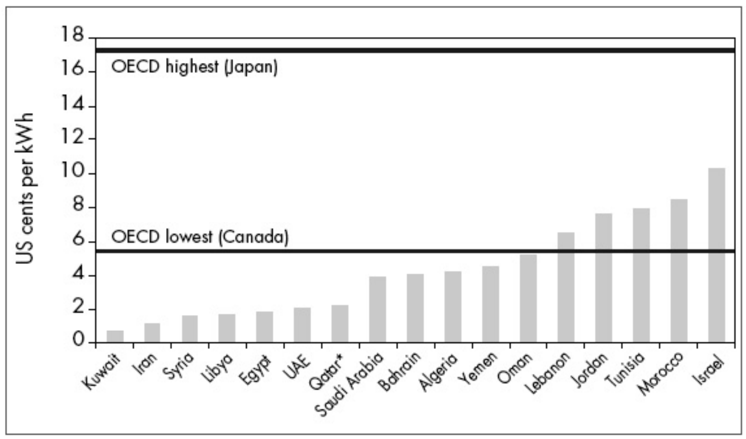
[16] i.e. gas produced on its own account, not as a by-product of oil extraction.

Where do the Subsidies Go?

At present, most MENA countries subsidize electricity, and all countries subsidize hydrocarbon products. (Chapter 4 explains where the subsidies are biggest and smallest). The mechanisms used to subsidize energy differ between oil-exporting and -importing countries.

Subsidies on electricity. When benchmarked against OECD electricity prices, electricity prices in the region do not even cover the long-run marginal cost of supply (figure 3.4). Electricity is generally considered to be a public service that the government provides to its citizens, and, in resource-rich countries, electricity subsidies are seen as a way of distributing oil and gas profits. For example, electricity is free to Qatari nationals.

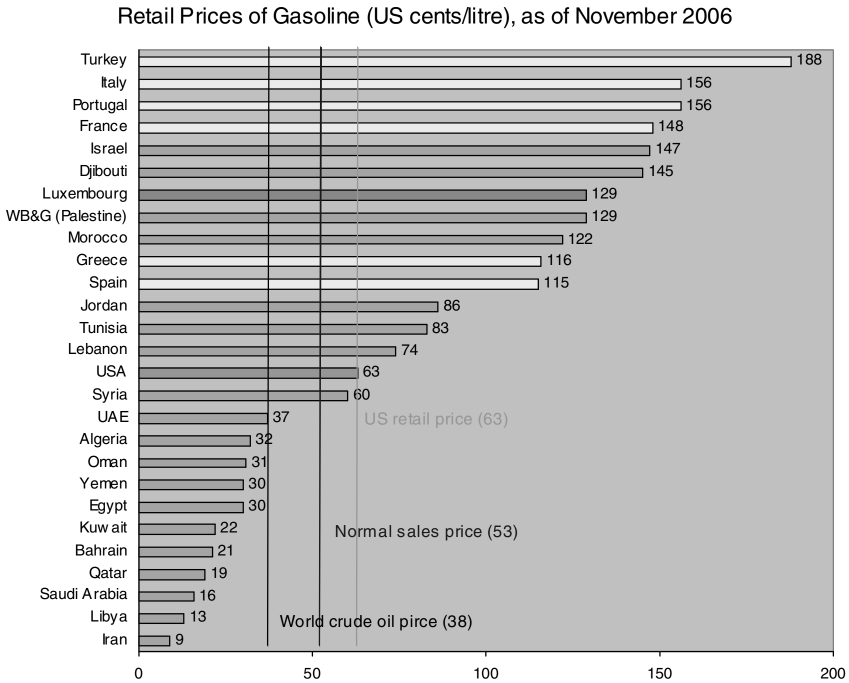
Figure 3.3. Electricity prices in MENA are low (2003)



Source: IEA 2005.

Subsidies on hydrocarbon products. According to a recent survey (GTZ, 2007) MENA countries heavily subsidize the retail prices of gasoline and diesel fuel. In 2006, retail diesel prices in 15 of 19 MENA countries with available data were lower than prices in the United States, and gasoline prices in 12 of the 19 countries were lower than in surrounding Mediterranean countries (Italy, France, Greece, Portugal, Spain, and Turkey) (figure 3.4). In 10 countries, including Egypt, Iran, Libya, and Saudi Arabia, fuel prices were less than half of the international price for the crude oil equivalent.

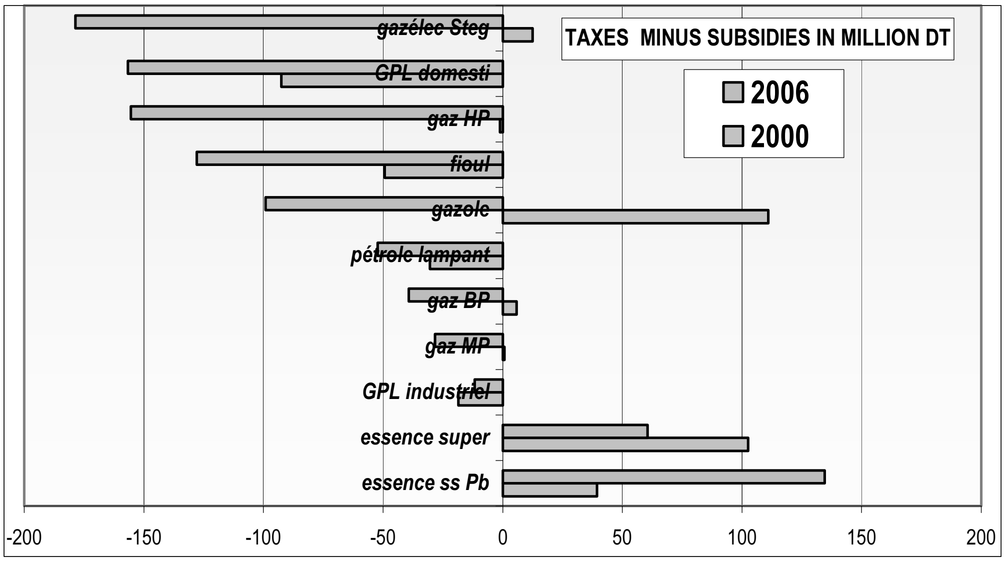
Figure 3.4. Retail prices of gasoline are subsidized in MENA, November 2006



Source: Derived from Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) 2007
1. Data unavailable for Iraq and Malta in the MENA region; other countries added for reference.
2. World crude oil price is Brent spot price in November 2006.
3. Normal sales prices are estimated theoretical price, hard to determine. GTZ (2007) get 'normal sales prices' by deducting highway tax levied in the USA, i.e. 10 US cents per liter, from the US prices.
4. USA pricing reflects commercially calculated full-cost prices as its fuel market is characterized by a high intensity of competition. USA prices are average cost-covering retail prices including industry margin, VAT and including approximately 10 US cents for the federal and state road funds.
5. Luxembourg fuel prices reflect an orientation level in the European Union, whose member states are obliged to impose minimum of 37 US cents/liter on unleaded gasoline and 31 US cents on diesel fuel.

Rising world fuel prices have widened gaps between world prices and domestic prices, and increased subsidy rates, even in Tunisia, where energy subsidies are among the lowest in the region (figure 3.6). The total cost of subsidies for nearly every kind of fuel increased between 2000 and 2008. Subsidies are particularly high for natural gas used for electricity generation and other industries, and for diesel and LPG.

Figure 3.6. Fuel subsidies in Tunisia increased between 2000 and 2006



Source: ESMAP, 2008

How are Subsidies Transferred?

The transfer of oil subsidies varies from country to country. In oil-producing countries with large foreign private sector involvement and production-sharing agreements (PSAs) as in Egypt and Yemen, the key subsidies are embedded in such PSAs for domestic oil and natural gas. The government sells part of its share of domestic production at below-market prices to domestic consumers and purchases some of the private firm's share at an agreed official price, again to sell at artificially low prices in the domestic market. Only the latter is recorded in the government's budget and is the only recorded subsidy (i.e., the cost of upstream energy purchases from private suppliers minus the revenue from its sale). The opportunity cost of the government's share in the PSAs or of the private supply at the official price, compared to a potential export price, is largely part of the implicit subsidy. In MENA, the majority of oil and gas production is through national oil companies (NOCs) which price output for the domestic market below the price obtained on export markets. The opportunity cost of the domestic price as compared to the export price is the implicit subsidy, but is not registered as such in the government's budget. The NOCs are not compensated for the foregone income.

In oil-importing countries, the government establishes the domestic wholesale or retail price of products below the market price, and compensates the importing companies (public or private) or the refineries.

Electricity subsidies are effected in two steps: through subsidized oil or gas prices to power companies, and through the structure of tariffs charged to various types of consumers, with or without compensation of the utilities. In Yemen, for example, petroleum subsidies were estimated to represent about the same amount (13YR/kWh) as the average electricity tariff in 2008 (World Bank, 2008d).

Who Benefits from Energy Subsidies?

The rich capture most of the benefits: because they are richer, they consume more subsidized energy.

In Egypt, for example, electricity subsidies benefit mostly the residential sector. The structure of tariffs reflects considerations of social welfare, with increasing block tariffs to make electricity affordable for the poor. However, a 2004 analysis found that individuals in the highest-income quintile received more than two-and-a-half times the energy subsidy received by the poor (CAPMAS, 2004 and table 3.4). The wealthiest 20 percent of the population received 93 percent of gasoline subsidies, because they own most of the vehicles. Similarly, they received 65 percent of natural gas subsidies because the gas network reaches only the wealthiest urban neighborhoods. The kerosene subsidy is an important exception to this pattern; it is the fuel of poor households. LPG subsidies, although benefiting all income groups, still benefit relatively more the higher income quintiles.

Table 3.3. Absolute transfers from oil and gas subsidies in Egypt, by household consumption quintile

Egyptian pounds per month per capita

Product	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5	Overall
Kerosene	2.51	1.97	1.49	1.25	0.74	1.61
Natural gas	0.12	0.31	0.49	0.75	3.13	0.96
Gasoline	0.02	0.05	0.18	0.28	7.53	1.59
LPG	6.23	8.22	9.32	10.68	10.89	9.13
Above Four Products	8.88	10.55	11.48	12.96	22.29	13.29
Value of Four Subsidy as % of Consumption Value	7.66	6.51	5.66	4.93	4.07	5.15

Source: HIECS, July-September 2004.

In Yemen, the richest 10 percent of households was found in 2003 to be receiving 40 percent of all subsidized diesel, while the poorest 20 percent received only 2 percent. The subsidy for kerosene was distributed more equally (table 3.4). Energy subsidies reduce the amount of money that can be spent on programs that really benefit the poor. In Yemen, the petroleum subsidy, which benefits only about 23 percent of the poor, costs the government 10 times as much as specific and targeted poverty reduction programs, such as the Social Welfare Fund (SWF), the Social Fund for Development, and the Public Works Program, which reach a much greater share of the poor population (World Bank 2008c).

Table 3.4. Yemen: share of direct petroleum subsidies received by each income decile

	d[1] lowest income decile	*d[2]*	*d[3]*	*d[4]*	*d[5]*	*d[6]*	*d[7]*	*d[8]*	*d[9]*	*d[10] highest income decile*
LPG	5%	7%	9%	7%	10%	10%	12%	11%	13%	16%
Kerosene	13%	13%	13%	9%	9%	9%	11%	8%	7%	7%
Diesel	1%	1%	4%	4%	6%	3%	12%	13%	17%	40%

Source: ESMAP, 2005.

How do MENA governments raise funds to pay for energy subsidies? Although taxes on income, profits, and capital gains affect mostly the rich, the same is not true of sales taxes, which affect all consumption. In most MENA countries, sales taxes are a major source of government revenue. But fuel subsidies also represent a high share of sales taxes. So, much of the cost of lowering energy prices is achieved by raising the prices of other goods and services for consumers. In Algeria, Egypt, Iran, and Jordan, for example, energy subsidies add at least 20 percent to the rate of taxation on goods and services (table 3.5).

Table 3.5. Energy subsidies relative to taxes on goods and services in selected MENA countries, 2006

	Taxes on goods & services (% of GDP)	Taxes on income, profits and capital gains (% of GDP)	Energy subsidies as % of GDP	Energy subsidies as % of taxes on goods & services
Algeria	28	3	8	27
Egypt, Arab Rep.	6	8	12	216
Iran, Islamic Rep.	1	5	18	2431
Jordan	12	4	3	23
Morocco	10	8	1	14
Tunisia	10	8	2	15

Source: WB-WDI database, 2006 data and Carey, 2008

Do Businesses Depend on Energy Subsidies?

Even if energy subsidies are not pro-poor, it is argued, companies may need them to survive. Energy subsidies support employment, the reasoning goes. Analysis of the data suggests that most MENA industry is not dependent on energy subsidies overall, but the average conceals important differences between sectors.

How would reductions in fuel subsidies affect industrial costs in Egypt (table 3.7) and Morocco (table 3.8)? Each table shows a different selection of sectors. The figures are based on input-output tables produced by national statistical institutions. According to these data, the full removal of energy subsidies would raise costs and prices in manufacturing in these countries by 0–14 percent. At the top end of the scale are more fuel-intensive activities such as transport, fisheries, and construction. But some specific industries are highly energy intensive. To give one example, Bahrain provides cheap electricity to the Bahrain Aluminum Company (Balco), which has one of the largest smelters in the world. This single customer accounts for about one third of total electricity demand in Bahrain.

Table 3.6. Egypt—the sectoral impact of fuel subsidies: low and uneven

Sector	Subsidy reduction (in percentages)	
	60%	100%
Manufacturing		
of paper and paper products	1.3	2.2
of chemicals and chemical products	0.9	1.5
of fertilizers and nitrogen compounds	2.4	4.1
of glass and glass products	1.9	3.3
of cement, lime and plaster	6.4	10.9
of articles of cement, lime and plaster	0.5	0.9
of basic iron and steel	2.7	4.5
Casting		
of iron and steel	1.9	3.5
of basic precious and nonferrous metals (including aluminum)	1.6	2.9

Source: Khettab, 2007; using 2006 CAPMAS data.

The low average impact of subsidies on costs means that most energy subsidies to industry are reducing the costs of production for economic activities that would take place anyway. In other words they are a transfer from the taxpayer to producers and consumers.

Some specific industries, however, depend on energy subsidies for their survival. If they would be unprofitable without energy subsidies, this means that the value of the inputs they use (including energy subsidies) is greater than the value of the outputs they produce (their contribution to the economy). In these cases, energy subsidies are encouraging entrepreneurs to invest in activities that reduce economic growth, thus diverting investment away from value-adding activities.

Table 3.7. Morocco—price adjustment simulation following oil product subsidy elimination

Sector	% rise
Transport	16
Fisheries	14
Other manufacturing industries	14
Extractive industries	12
Electricity and water	10
Construction sector	10
Chemical industry	8
Food industry	6
Mechanical, steel and electrical industries	6
Commerce and repairs	6
Public administration and security	6
Textile and leather industries	5
Hotels and restaurants	4
Agriculture	4

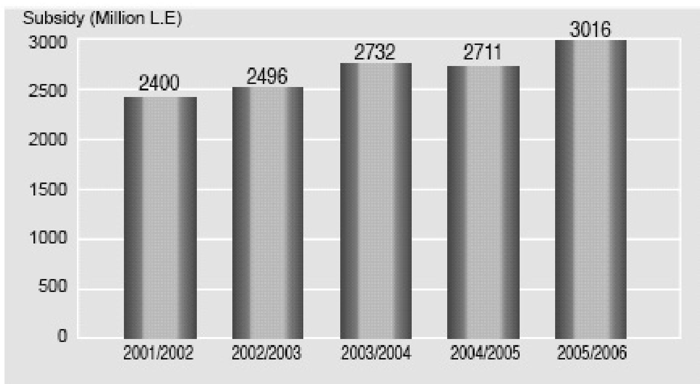
Source: World Bank, 2008b.

Can Energy Efficiency Improve Fiscal Balances?

MENA governments have expressed increasing concern that the weight of subsidies on their fiscal situation is unsustainable. Fiscal deficits affect both energy-exporting and energy-importing countries.

Eight countries are already experiencing a significant budget deficit, four among net exporters: Egypt, Iran, Syria, and Yemen, and four among net importers: Jordan, Lebanon, Morocco, and Tunisia. In Egypt, the cost of these subsidies (at current prices) increased by 25 percent between 2001/02 and 2005/06 (figure 3.6). As mentioned in preceding sections, the continued increase in oil prices is further exacerbating the situation.

Figure 3.6. Growing energy subsidies in Egypt 2001/02–2005/06



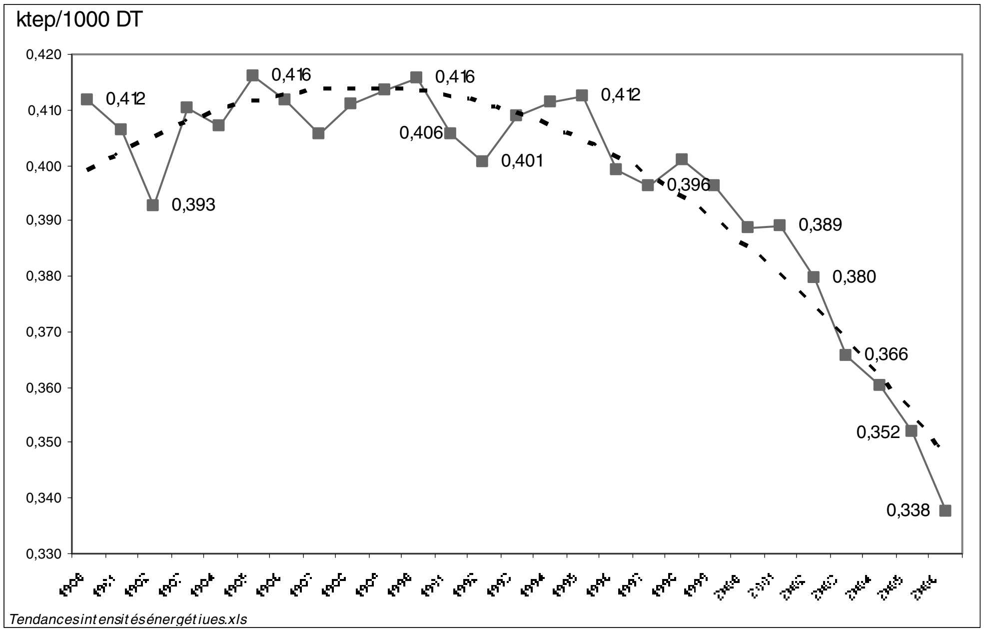
Source: EEHC, 2007.

Better energy efficiency would therefore assist the region's fiscal management in three ways:

- through a reduction of consumption, therefore, a reduction in budget outlays on subsidies, which could then be allocated to social expenditures; this would be the most important fiscal impact of energy efficiency by far;
- through an expansion of GDP, therefore on increasing fiscal revenues; and
- through a reduction of households' expenditures on energy, which would reduce the claims on the government for social safety net support.

Tunisia has shown how improved energy efficiency can produce subsidy savings. After a difficult start during the 1980s, energy efficiency gains led to a remarkable decrease in the energy intensity of the economy, between 1990 and 2000. Renewed efforts, as a response to the steady increase in oil prices, led to a 13 percent decrease in energy intensity between 2000 and 2006 (Figure 3.7), with a sharp acceleration since 2004. Current evidence from Tunisia shows that the energy efficiency gains achieved during 2005–2007 are now generating annual fuel savings of 390 toe (tons of oil equivalent), which is 0.7 percent of total energy consumption. In turn this represents potential annual budgetary savings of TD 300 million (US$40 million) per year.[17] Other countries in the region have higher subsidies and higher levels of energy intensity than Tunisia, so the potential fiscal savings are greater.

Figure 3.7. Energy intensity declines over time in Tunisia



ESMAP (2008)

Conclusion

With subsidies representing on average 7.1 percent of GDP (2006) and over 20 percent of government spending, the MENA region is one of the regions that spends the most on energy subsidies. In the majority of countries, all fuels and electricity are subsidized.

The cost of subsidies to the economies is extremely high, and they rarely benefit the social groups or the sectors that justifiably need them. They do not benefit the poor very much, but they benefit the middle and upper income classes. Few productive sectors depend on energy subsidies for their survival; those that do are probably making a negative contribution to the economy. With increasing oil prices, the fiscal impact continues to worsen, diverting public expenditures which could have greater social and economic returns.

The example of Tunisia shows that aggressive energy-efficiency programs pay off in terms of fuel savings, and potentially significant reductions in the fiscal impact of energy subsidies.

[17] Assuming that subsidies of TD 1.3 billion in 2006 represented 3 percent of the government budget of DH 45 billion.

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Appendix 3.1: Energy Subsidy Estimates

Country	Major types of energy subsidies	Percent of GDP	On-budget	Off-budget or Implicit	Overall Fiscal Balance	Government spending as share of GDP
Middle East						
Iran	Fuel (explicit and implicit)	17.5	2.1	15.4	-0.3	26.0
Yemen	Fuel (explicit)	7.7	7.7		-0.2	35.6
Syria	Fuel (mainly implicit on diesel)	12.2	2.0	10.2	-5.7	27.6
Jordan	Fuel (explicit)	2.8	2.8		-3.8	38.9
Iraq	Fuel (explicit and implicit)	16.5	4.5	12.0	12	68.5
Lebanon	Electricity (transfers to EdL)	4.0	4.0		-8.2	23.1
GCC						
Saudi Arabia	Fuel (implicit)	6.8		6.8	21.4	32.7
Qatar	Fuel (Implicit)	1.3		1.3	9.1	32.7
Kuwait	Electricity, water, fuel (explicit), gas (implicit)	9.1	6.0	3.1		39.8
Bahrain	Fuel (explicit)	1.7	1.7			26.2
Oman	Electricity (explicit), fuel (implicit)	2.3	0.9	1.4		34.3
UAE	Electricity & water (explicit), fuel (implict)	1.8	0.7	1.1	28.8	21.7
North Africa						
Egypt	Fuel (explicit and implicit)	11.9	6.9	5.0	-7.7	32.9
Tunisia	Petroleum subsidy and electricity	1.5	1.5		-2.8	26.7
Libya	Implicit energy subsidies	15.0		15.0	38.6	32.3
Algeria	Implicit energy subsidies	7.5		7.5	11.9	30.0
Morocco	Fuel (mainly butane), explicit	1.3	1.3		-2.1	27.6
Average		7.1	3.2	7.2		

Source: Carey, 2008, based on IMF Article IV Staff Reports and Statistical Appendices

On-budget numbers are those which appear as an energy subsidy line item in the fiscal accounts. Off-budget numbers can be other fiscal activities which ultimately reflect direct subsidies or other interventions which result in below-market energy prices. The IMF reports generally cite aggregate numbers from World Bank studies for the latter.

Note: The estimates for Saudi Arabia, Oman, and the UAE are based on data on consumption and retail prices of major fuels. They do not include provision of natural gas to industrial users, due to data deficiencies.

Sources and Methods for Energy Subsidy Estimates

Budgetary Item(s)		Direct calculation of foregone revenue from price gap	Citation of foregone revenue or implicit subsidy	Estimates which include natural gas
Morocco	Lebanon	Saudi Arabia	Egypt	Egypt
Tunisia	Jordan	UAE	Libya	Algeria
Kuwait	Yemen	Qatar	Iran	Iran
Bahrain	Iraq	Oman	Algeria	
Egypt	Syria		Iraq	
			Syria	

Source: Carey, 2008.

Chapter 4: Energy Prices and Energy Efficiency

In this chapter, we examine how well energy prices in the MENA support policies to improve energy efficiency.

The aim is to see how the pattern of energy prices in MENA affects energy efficiency, *not* to specify how energy should be priced at any given time in any specific country. Each country's energy market has its own peculiarities. Also, the analysis was conducted at a time of dramatic energy price changes, both on world markets and within some MENA states; more detailed exercises would be required to arrive at tariff and pricing recommendations for a particular country at a specified time.

Energy prices in MENA are generally administered by governments, instead of being determined by markets. This is because some energy supply technologies (such as electricity and piped gas) create a natural monopoly, so that retail prices have to be administered, partly to protect users from the abuse of market power by service providers, and partly for political reasons. Petroleum-product prices are also administered, for similar reasons: to prevent abuse of market power and for political reasons.[18]

This chapter does not discuss the best way to structure an energy market, although the question of how energy prices are influenced by the structure of energy markets is important. For this study, MENA's existing market structures are taken as given.

The chapter makes two main points:

- Energy pricing should provide the right economic signals to persuade energy consumers to use energy efficiently.
- MENA countries have ample room to adjust energy prices towards economic pricing. This does not just mean raising prices. It also involves using rate structures to sharpen price signals, and maintaining flexibility in the price setting process to respond to changes in supply costs and demand patterns.

Economic pricing means charging energy users the cost to the national economy of the energy they use. Otherwise, people and firms will use low-priced energy for low-value activities in ways that reduce the value of national economic output.

Consider this example from the residential sector. Suppose that electricity costs $0.15 to supply and that households have the choice between a $5 energy-saving CFL bulb and a $0.75 incandescent bulb. If households choose the CFL, the economy will be $47 better-off per bulb in lighting cost after 5 years, the difference between the two lines in figure 4.1.a. But suppose that households pay $0.03 per kilowatt-hour (kWh) for this electricity. At $0.03 per kilowatt-hour, it

[18] We examine the social side of energy pricing in chapter 5.

would take this household a year and a half to recover its investment in CFLs. After five years, the household would have saved only a third of its lighting costs—even though it would have used 75% less power (figure 4.1b). With electricity this cheap, the household would be quite unlikely to invest in the energy-efficient option.

This example shows that when energy is subsidized, private decision-makers may not make the best energy-efficient choice for the nation. Multiply this simple result by the number of households, firms, and energy-using activities in the country shows how the right energy pricing for improving energy efficiency at the micro level can have major economic implications at the macro level.

Figure 4.1.a Energy-efficient lightbulbs (CFLs) can save the economy $47/bulb over 5 years…

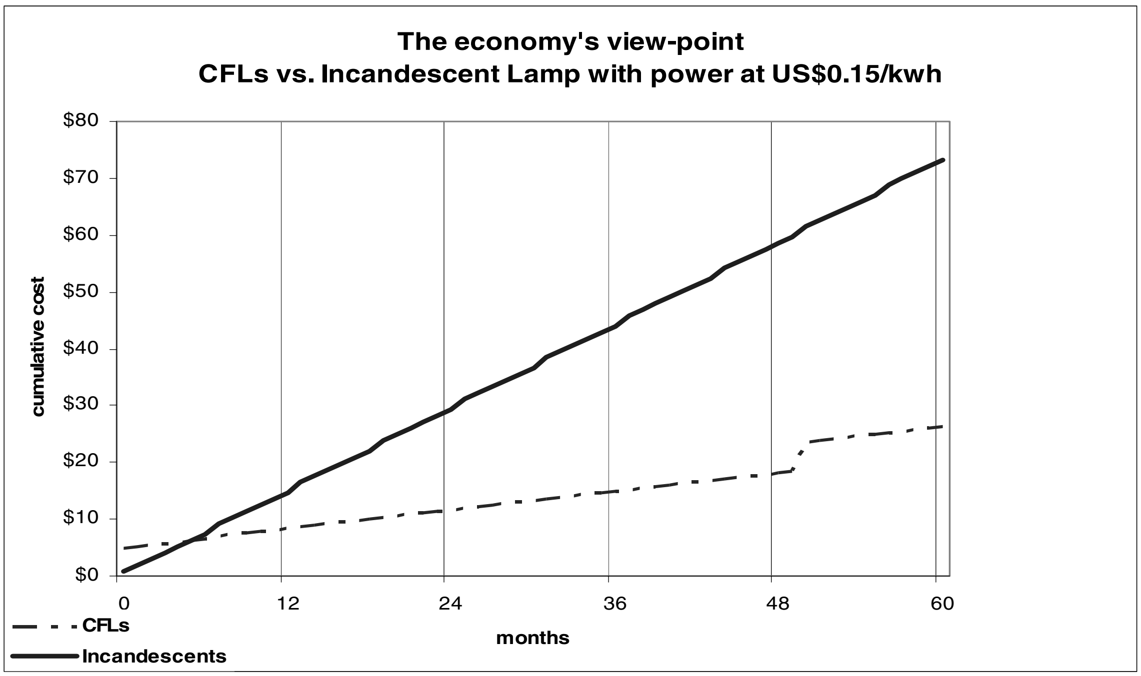
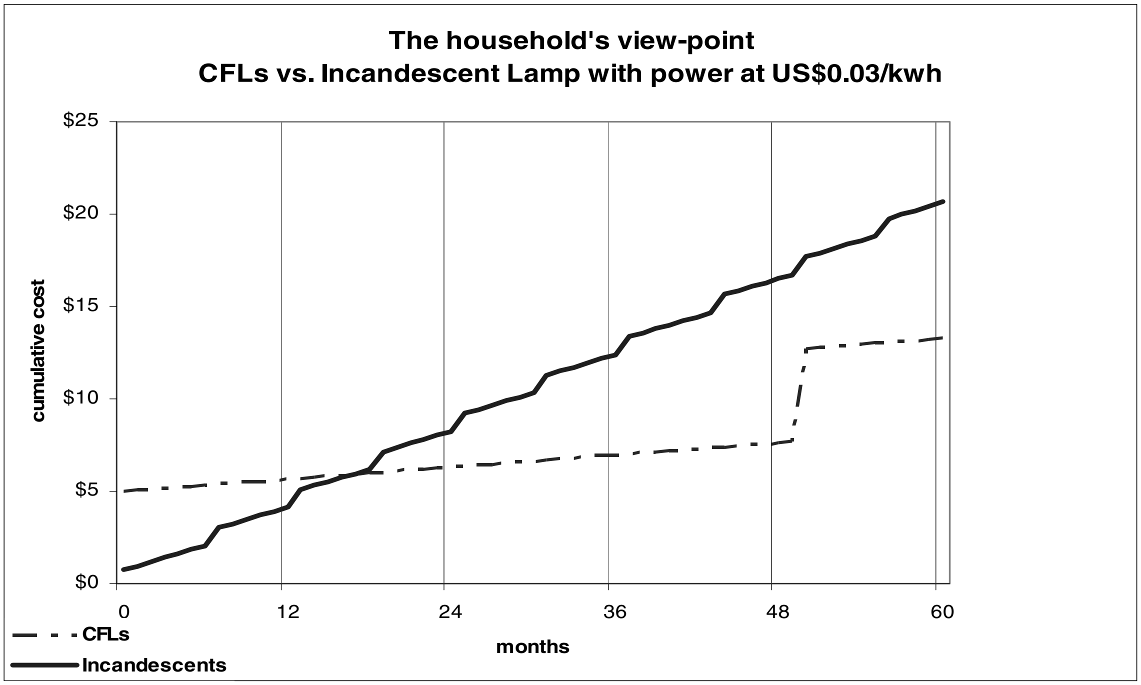


Figure 4.1.b …but households feel little benefit from CFLs with electricity billed at $0.03/kwh



Assumptions: A 15 watt CFL bulb costing $5.00 is compared with a 60 watt incandescent bulb with the same lumen rating and costing $0.75. CFL lifetime: 6,000 hours; incandescent bulb lifetime: 1,500 hours; usage: 4 hours/day.
Source: Model from http://www.susdesign.com/cfl/index.php, accessed June 2, 2008.

The first section of the chapter-addresses the pricing of electricity; the second, the pricing of petroleum products; and the third, options for adjusting pricing practices in the region.

Electricity

This section first reviews the principles of electricity pricing and the categories of users identified for the assessment. Then it discusses three main questions:

- What benchmarks should be used for the economic pricing of electricity and how do MENA countries compare against those benchmarks?
- How can MENA countries deal with the volatility of fuel prices?
- What is the impact of electricity prices on electricity demand?

The Three Principles of Electricity Pricing

In order to use energy efficiently, electricity users should be aware of the costs that their consumption imposes on the electricity-supply system - and, therefore, on the economy. Thus, the challenge is to provide information about these costs through pricing in a clear and timely way.

This requires that electricity pricing satisfy three principles: efficiency, flexibility, and transparency.

Efficiency requires that prices cover the costs of investments and efficient operations for electricity supply. Prices should fully cover both economic costs and suppliers' financial costs. Ideally, they should also allow the government to tax the power sector at the same rate as other economic activities, so as to avoid economic distortions between sectors.

- In economic terms, electricity prices should reflect the lowest economic costs of providing electricity. They should therefore cover the marginal costs of meeting user demand at the lowest feasible cost. Where marginal costs are below average costs, average prices should cover average financial costs.
- In financial terms, electricity prices should allow suppliers to earn a rate of return on investment that is competitive in the capital markets for the type and level of investment risks involved.

Prices should also cover costs imposed on society by electricity production, transmission, and distribution that are not borne by suppliers. These may include the costs of environmental damage, government loan guarantees, and social programs.

Flexibility requires that electricity prices should change in line with changes in supply costs over time, but not to the extent of being volatile. In the short term, the costs of the fuels used to generate electricity are the main source of supply cost changes. In many countries, the process of administering retail electricity prices includes automatic provisions for passing changes in fuel costs to retail prices periodically, for example every year. In this way, power suppliers provide the valuable service of smoothing electricity prices for users, whose investments in electricity appliances limit their flexibility to change their patterns of electricity use. In the long term, however, electricity prices should also reflect changes in the costs of supply capacity because these costs are significant for such a capital-intensive industry.

Flexibility also means that suppliers should offer users a choice of pricing schemes. Consumers respond to changes in electricity prices in various ways, depending on factors such as the way they use electricity (large or small, level or intermittent, and so on), the value they place on electricity, their access to other energy sources, and the availability of equipment that helps adjust their electricity consumption.[19] For example, a supplier can offer an interruptible rate schedule that offers cheaper electricity in return for accepting cutoffs when supply is tight. Many users may prefer, however, to receive an uninterruptible electricity supply and pay predictable flat rates for it.[20] Suppliers can offer to them various combinations of fixed charges related to the

[19] A modern example of this equipment in industry is smart metering, which monitors electricity usage continuously and—in combination with real-time price signals—remotely controls the operation of electric equipment to reduce electricity use during high-price periods. If such pricing signals elicit substantial consumer response, they could significantly reduce marginal costs and the need for new supply capacity.

[20] Under such rates, marginal costs and supply quality premiums are averaged over a year so that users see only a single price per kilowatt-hour (kWh) at all times throughout the year.

user's maximum demand and per unit variable charges for the user's energy consumption and let users choose the combination that charges them least for their consumption patterns.

Transparency requires electricity price schedules to be publicly accessible and easily-understood regarding the costs of supplying each service in each market segment. Making these costs publicly accessible and understandable will relieve users from expending time and effort to discover how much they have to pay for their electricity consumption.

A differentiated pricing structure is an important aspect of transparency. It accurately signals to users the cost of meeting demand according to timing, location, and quality of supply. A differentiated tariff structure also shows suppliers where they should invest or cut costs. This information is hidden by prices that are uniform across consumption periods, locations, and supply qualities.

Time-of-use (TOU) pricing is a powerful form of price differentiation. It gives a strong incentive for users to consume electricity efficiently. TOU pricing is designed to modify the pattern of consumption, and can be effective even when the price levels are generally below supply costs. This is because it relies on higher relative prices in peak load periods than in off-peak periods. It therefore complements the incentive provided by the overall level of electricity prices to use electricity efficiently. To provide price signals that induce users to respond, TOU rates must offer substantial differences between peak load periods and off-peak load periods. TOU pricing works by moving some of the consumption out of the periods of peak demand on the power system, either to off-peak periods or off the system altogether. This incentive reduces the growth in peak load, which has the economic benefit of delaying investment to supply the higher capacity necessary for meeting growth in peak load. A second economic benefit is that additional capacity can be designed to serve the system's base load instead of its peak load. This benefit stems from the considerably lower average cost of electricity supplied from base-load capacity when operated at high utilization rates, compared to the average cost of electricity supplied from peak load capacity when operated at low utilization rates. Much of this cost difference arises from spreading the fixed capacity costs over much more energy output under base-load operation than under peak-load operation. It also arises from the lower costs and higher generation efficiency of the fuels used for base-load supply than the fuels used for peak-load supply.

Industrial and commercial users of electricity should be willing and able to adjust the timing of their electricity consumption to take advantage of TOU rates, because they can thereby save a substantial amount of their considerable expenditures on electricity. Residential users have less flexibility to respond to TOU rates, although they may adopt simple measures to reduce their electricity bills by switching electricity consumption to low rate periods.

Well-designed pricing structures that are easily understood by users, however, cannot perfectly match cost structures. This is because cost structures become complex when the ratio of fixed to variable costs varies over time, as demand and fuel costs fluctuate, and different locations and voltages have different cost structures. Moreover, tariffs cannot be changed as frequently as costs change in volatile fuel markets, so price adjustments tend to lag behind changes in costs.

The variability of electricity-supply costs cannot be smoothed out by drawing on stocks—as with commodities generally—because electricity cannot be economically stored. So the aim is to reach the best *practical* fit between price and cost structures, even if this fit is not perfect.

Assessing Electricity Prices in MENA: A Benchmarking Approach

How closely do MENA's electricity tariffs match the supply cost structure? To answer this question, tariff schedules and supply cost data need to be available.

Although the tariffs paid by major power users are often negotiated bilaterally between the user and the supplier, and often remain confidential, the published tariffs for residential and medium-to-small commercial users are fairly easy to obtain for most countries, and give a representative picture of electricity pricing in MENA.[21] Supply cost data, however, are difficult to work out directly. To do this would require vast amounts of technical and financial information, most of which is not publicly available.

The approach taken in this report, therefore, is to compare the electricity tariffs of countries in MENA against a benchmark value derived from electricity tariffs in the northern Mediterranean countries of France, Greece, Italy, Portugal, Spain, and Turkey. Under current European Union (EU) policies, electricity suppliers in these countries are more or less required to cover their financial and environmental costs.[22] A MENA tariff well below this benchmark level would therefore indicate uneconomic pricing.

This approach to benchmarking is adopted because the plant and equipment used across the electricity-supply chain and the fuels used to generate electricity are presently fairly standard around the world; are procured in competitive international markets[23]; have, therefore, observable international prices; and account for a high proportion—usually more than 80 percent—of the total economic cost of power supply.[24] In other words, most of the resources used to supply electricity are internationally tradable; hence, each country's opportunity cost for using electricity is also faced by other countries because this cost is based on prices for inputs that are set in international markets for these resources.[25] For example, in countries which use tradeable liquid

[21] *Source:* The data on electricity tariffs used in this Chapter was obtained from websites on national power suppliers, energy regulators, and energy ministries. As prices varied significantly, a snapshot of prices in the period October-December 2007 was used. For details on the sources of the data, see Appendix 4.1for MENA countries and Appendix 4.3 for benchmark countries.

[22] One reason for this EU policy is to avoid distortions to electricity tariffs that impede fair trade.

[23] The share of renewable energy is still quite low in MENA, and the equipment used to capture it is internationally traded.

[24] This assertion includes the costs of externalities that are borne directly by power suppliers, such as equipment to control the emission of pollutants. It does not include the costs of externalities that are borne indirectly by society.

[25] The remainder of the supply cost consists largely of local labor costs, but any variation in this cost across countries is too small to invalidate this benchmark. Where labor costs are relatively high, more capital is likely to be employed and all factors are likely to be used more efficiently, which dampens the impact of higher labor costs on the overall supply cost.

fuels to generate electricity, the economic value of these fuels determines at least the short run marginal economic cost of fuel for generation.[26]

A major caveat – generation from natural gas

The assumption that countries in the MENA and northern Mediterranean regions share a common set of opportunity costs for electricity supply may not apply unreservedly to MENA countries that produce electricity from their own resources of natural gas, for two possible reasons. The first is that in some countries the transport costs for the relatively small amounts of gas that they could export would be too high to be competitive in international markets, and so the opportunity cost of using their natural gas cannot be based on export values. The second is that in other countries the opportunity cost of using their natural gas for power generation is the netback value of exporting their natural gas competitively in international gas markets, and is therefore lower than the cost of natural gas used for power generation in countries that have to import natural gas for this purpose. These countries face a lower opportunity cost for power generation than the benchmark values, since the northern Mediterranean countries import natural gas for power generation.

The MENA countries that qualify for this caveat have to generate most of their electricity from their own natural gas, and natural gas has to be their marginal source of electricity. The countries that fall into this category, generating at least 65 percent of their electricity from natural gas, are Algeria, Bahrain, Egypt, Iran, Oman, Qatar, Tunisia and the UAE (IEA 2007).

Of these countries, Bahrain and Tunisia do not qualify for the caveat because they import natural gas for some or most of their supply,[27] and so have to pay international prices. Hence, the same benchmark values used for non-gas users also apply to these gas users.

However, Algeria, Egypt, Oman, Qatar and UAE currently export large quantities of natural gas both by pipeline and/or as LNG, and so meet the conditions for the caveat.[28] Iran joins this group because it is not constrained by high transport costs in either mode from exporting its natural gas, as it has sufficient reserves of natural gas to derive the scale economies in production and transportation necessary to be competitive. Hence these seven countries, out of all MENA countries, warrant a lower benchmark value than adopted generally for the regions.

One measure of this difference in benchmark values is the additional cost of transporting natural gas to export markets. In the case of LNG for these countries, this cost amounts to around

[26] The economic value of natural gas would represent the long run marginal cost of fuel in these countries if future additions to power generation capacity are based on natural gas.

[27] Source of information used for MENA natural gas production and consumption: Energy Information Agency, U.S. government. http://www.eia.doe.gov/emeu/international/gasproduction.html

[28] Libya also exports natural gas, but it does not meet the criterion of generating 65% of its power from natural gas.

$3 per MMBtu[29], which is equivalent to US$0.022/kWh of electricity delivered to consumers when produced in a CCGT plant.[30]

Notwithstanding these economic considerations, however, MENA countries that produce natural gas price it for domestic use at below its value as an exportable commodity, even though the export value of gas is in turn depressed by the high costs of export (Table 4.1). This means that their low domestic electricity prices reflect non-economic pricing.

Table 4.1. Natural Gas Pricing Framework ($/MMBtu)

	Gas Price in 2006	Net Gain from LNG Export	
		at 10% discount rate	at 5 % discount rate
Algeria	0.85	2.25	3.05
Egypt	1.19	2.61	3.15
Iran	0.35	1.27	2.20
Qatar	0.85	2.31	3.08
Iraq	not available	not applicable	
Kuwait	0.60	not applicable	
Libya	0.90		2.69
Saudi Arabia	0.75	not applicable	
UAE	1.05	not applicable	
Yemen	not available	2.66	3.02

Source: Razavi 2008

Which prices to benchmark?

Given the considerations described in the previous section, electricity prices in MENA are assessed against supply costs for two categories of electricity users:

- Residential users
- Industrial users

These two categories were selected from the many consumer categories usually found in an electricity tariff schedule, because they involve substantially different supply costs. The unit cost of supplying a residential user is one of the highest among these categories, while that for an industrial user is one of the lowest. This is because a residential user is supplied at a low voltage level and consumes a relatively small amount of electricity, mostly within a few hours each day that coincide with the peak loading on the power system.[31] An industrial user is supplied at a medium- or high-voltage level, and consumes a relatively large amount of electricity over many hours each day—some users at a steady level—throughout the peak, intermediate, and low-load duration periods on the power system.

[29] World Bank staff estimate based on country studies.
[30] This cost includes an allowance of 15% for energy losses in transmission and distribution networks.

[31] Supply at lower voltage levels incurs higher technical network losses of energy than supply at higher voltages, and additional investment and operating costs for stepping down voltage levels and for low voltage distribution networks.

In most countries, the prices for residential users are computed in terms of charges for a range of monthly consumption levels between 100 kWh and 1,300 kWh, increasing in steps of 200 kWh. This is because many MENA countries use rising block-tariff rates—whereby the rates start at a relatively low level for the first block of 100 kWh (50 kWh in some countries) and rise in successive blocks of 100 kWh or 200 kWh up to a plateau that varies from 500 kWh to over 2,000 kWh across countries. Governments use this pricing structure to provide indirect income support to low-income households.

The prices for industrial users are shown in the two forms that are generally used in MENA countries. One is a flat rate per kWh of energy consumed; the other is a rate that varies with TOU according to defined peak, intermediate, and off-peak hours. Both forms generally carry a flat monthly charge per kilowatt (or kilovolt-ampere) for the user's maximum load served (or the maximum contracted load). Many tariff schedules offer a range of tariff options for industrial users that are linked to load size and consumption pattern (ranging from low-energy usage to high-energy usage for a given load). When a country has such a schedule, an option in the middle of the range is used for this analysis. This means that the industrial tariff rates analyzed only reflect the rates generally charged to industrial users as a whole.

Benchmark values for MENA electricity prices

Benchmark values for residential and industrial electricity users are used for assessing residential and industrial electricity tariffs in MENA countries for the reasons given above. These values are the averages of residential and industrial electricity tariffs in France, Greece, Italy, Portugal, Spain, and Turkey, as previously described, excluding taxes on electricity consumption and converted to U.S. dollars at the prevailing exchange rates. The fourth quarter of 2007 was selected as the period for comparison, because this is the latest period for which data are available on electricity tariffs for all the countries covered by this analysis. These benchmark values are given in Table 4.2.

For the reasons given above, Algeria, Egypt, Iran, Oman, Qatar and UAE qualify for a sub-set of benchmark values that are about US$ cents 2.2/kWh less than the values shown in Table 4.2.

Table 4.2 Benchmark values used for MENA electricity retail prices[1]

Residential consumers (LV) in cents/kWh	Monthly consumption (kWh)						
	100	300	500	700	900	1100	1300
	15.5	16.9	17.3	17.8	18.1	18.4	18.4

Industrial consumers (HV)	Maximum Demand charge (US$/kW/month)	Energy (US$cents/kWh)			
		Flat rate	TOU peak	TOU medium	TOU low
	5.5		21.3	11.3	7.0

Source: Computations based on published tariffs; Appendix 4.3.

Note: (1) Unweighted averages for France, Greece, Italy, Portugal, Spain, and Turkey of the cost to each type of consumer of consuming electricity under published tariffs for the fourth quarter 2007, excluding taxes.

(2) LV = supply at low voltage; HV = supply at high voltage; TOU = time of use.

These benchmark values should be considered only as broad indications of opportunity costs in MENA, because they are based on national tariff schedules that incorporate features unique to each country. The benchmark tariffs also show the following features of "good practice" in designing a cost-reflective tariff structure:

- Industrial rates are below residential rates outside peak load periods to reflect the lower costs of serving industrial users. But industrial rates are above residential rates during peak load periods to create the incentive to move industrial power load off peak periods. For example, the average industrial peak hourly rate ($0.21/kWh) is about 1.2 times the average residential rate ($0.18/kWh), but the average industrial medium-peak hourly rate ($0.11/kWh) is about 60% of the average residential rate.
- Residential rates increase modestly (by about 20 percent) from very low consumption to higher levels of consumption in these countries.
- Peak hourly rates ($0.21/kWh on average) are about three times the low-period hourly rates ($0.07/kWh on average).

Taxes on electricity consumption in the benchmark countries are significant: around 31 percent in France, 29 percent in Italy, 22 percent in Spain, 8 percent in Greece, and 5 percent in Portugal. Taxes are excluded from the assessment of benchmark economic costs, however, because the before-tax prices are considered to fully cover economic costs.

Comparison of MENA Electricity Prices against Benchmarks

For this assessment, electricity prices as of the fourth quarter 2007 for MENA countries were sourced from the Web sites of national agencies.[32] The prices were then converted to U.S. dollars at the prevailing exchange rates. Taxation in the forms of value added tax (VAT) and local taxes were identified for Israel, Morocco, Syria, Tunisia, and the West Bank and Gaza. Their average tax rate was 14.7 percent—about 75 percent of the average tax rate for the benchmark countries (19 percent).[33] Other MENA countries may also be taxing electricity consumption, but details of such taxes were not found. Prices for residential use are tabulated in Appendix 4.1 and the prices for industrial use are tabulated in Appendix 4.2. The average electricity prices for MENA countries are summarized in Table 4.3.

Table 4.3 Average electricity prices including sales taxes in MENA for fourth quarter of 2007, expressed in nominal U.S. dollars

Residential consumers (LV) in cents/kWh	Monthly consumption (kWh)						
	100	300	500	700	900	1,100	1,300
	5.6	6.1	6.5	7.0	7.4	7.5	7.7

Industrial consumers (HV)	Maximum Demand charge (US$/kW/month)	Energy (US$cents/kWh)			
		Flat rate	TOU peak	TOU medium	TOU low
	5.8	5.7	10.7	6.4	3.7

Source: Computations based on published tariffs; Appendixes 4.1 and 4.2.

[32] Electricity tariffs are published on the Web sites of a variety of national agencies, primarily those of power utilities, national energy regulatory agencies, and, in some cases, energy ministries.

[33] The average tax rate for the benchmark countries excludes Turkey, for which this rate was not found.

Analysis of the prices for MENA countries reported in Table 4.3 reveals the following relationships about MENA electricity tariffs in the fourth quarter of 2007:

- Countries with low rates for residential users had low rates for industrial users. Likewise, countries with relatively high rates for residential users had relatively high rates for industrial users.
- Residential rates in MENA countries, which averaged around \$0.07/kWh, were much lower than the benchmark values; they ranged from 36 percent of the benchmark value for very low levels of consumption, to 42 percent for high levels of consumption.
- TOU rates for industrial users were not widely adopted in MENA, since they were found in only 7 of the 19 MENA countries[34] covered by this analysis.
- On average, residential rates (from \$0.056/kWh to \$0.077/kWh) were slightly higher than the average flat industrial rates in eleven of the MENA countries (\$0.057/kWh), and were substantially lower than the average TOU industrial rates for peak periods (\$0.107/kWh) in MENA countries.
- But this average relationship between residential rates and industrial rates masked a wide range. Residential rates were higher than industrial rates in ten MENA countries but lower in nine other MENA countries. The latter cases do not indicate a substantial cross-subsidy of residential users by industrial users, because the rates for both categories of users were far below the costs of supply.
- In eleven MENA countries, residential rates did not rise at all or by little from very low levels of monthly consumption to high levels of consumption. In six other countries, they increased moderately (by a factor of between 1.3 times and 3.2 times). They increased steeply in Iran (by a factor of over 9 times) and Syria (by a factor of over 7 times).
- Peak hourly rates (\$0.107/kWh on average) were nearly three times greater than the low-period hourly rates (\$0.037/kWh on average) in the seven countries that used them for industrial tariffs. MENA TOU rates were only just over 50 percent of the corresponding benchmark values.

These averages are derived from wide ranges of national tariff rates, from the very low to the very high. MENA countries fall into four groups of tariff rates:[35]

- Djibouti stands out as having had by far the highest rates, around \$0.30/kWh for residential use and \$0.20/kWh for industrial use, which reflects the high running cost of small diesel generators.
- Israel, Morocco, Tunisia, and West Bank and Gaza had the next-highest tariffs, between around \$0.08/kWh and \$0.17/kWh for residential use and \$0.04 /kWh for off-peak industrial

[34] Algeria, Iran, Israel, Jordan, Morocco, Syria, and Tunisia.

[35] The rates for residential usage expressed in this grouping of countries refer to the monthly consumption level of 900 kWh per household.

use and $0.19 /kWh for peak industrial use. The residential rates for large consumption levels and the industrial peak TOU rates were nearly as high as the corresponding benchmark values. But the residential rates for low consumption levels and the industrial off-peak TOU rates were well below the corresponding benchmark values. West Bank and Gaza clearly covered its economic costs because it applied a substantial markup to the costs of imported electricity from Israel, its main source of electricity.[36]

- Algeria, Jordan, Lebanon and Yemen had rates between $0.06/kWh and $0.10/kWh for residential use, and between $0.06/kWh and $0.10/kWh for industrial use. Iran had residential tariffs in this range (except for the very low rates for low consumption levels), but much lower industrial tariffs. Syria had industrial tariffs in this range, but much lower residential tariffs. These rates were substantially below their economic costs of electricity supply.
- The remaining eight countries (Bahrain, Egypt, Iraq, Kuwait, Libya, Oman, Qatar, and Saudi Arabia) had extremely low electricity prices that constituted a small portion of the economic costs of supply. Their residential tariffs averaged less than $0.02/kWh and their industrial tariffs averaged less than $0.03/kWh. These countries are also MENA's major oil and natural gas producers, with the sole absence of Algeria. As shown later in this chapter, this trend also held true for petroleum products.
- Of the six countries – Algeria, Egypt, Iran, Oman, Qatar and UAE – that qualify for lower benchmark values for the reasons explained above, the electricity tariffs in Egypt, Iran, Oman and Qatar were clearly far below even the lower benchmark values. Electricity tariffs in Algeria were also well below these values, although substantially higher than for the four other gas exporters[37].
- Although the overall situation presented here about MENA's electricity tariffs rates applies to the fourth quarter of 2007, this situation has not changed much subsequently to date. Some changes have widened the gap between MENA's tariffs and the benchmark values, notably the increase in benchmark values in US dollar terms because of the depreciation of this currency against the euro, and increases in the electricity tariffs in euros for the benchmark countries.[38] This has been offset to some extent by increases in electricity tariffs in some MENA countries to contain the fiscal cost of subsidies.

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[36] This finding does not necessarily mean that West Bank and Gaza will not face pressure to increase its rates, because Israel's rates are sufficiently below the benchmark values to be liable to future increases. The West Bank was also connected to the Jordanian supply in February 2008.

[37] This analysis does not reflect any differences in billing and collection rates between MENA and benchmark countries. Imperfect billing systems and low collection rates are known to be an issue in some MENA countries.

[38] Increases in tariffs of the benchmark countries reflect increases in the international prices of fossil fuels and plant and equipment.

Coping with Volatile Generation Costs

Because electricity tariffs cannot be frequently changed for administrative, social, and political reasons, changes in tariffs lag behind changes in costs. The tariff analysis for MENA countries reported above presents a static picture because it focuses on a particular period—the fourth quarter of 2007. Tariffs are significantly below economic costs in many MENA countries primarily because many years have passed since tariffs were last adjusted and fossil-fuel prices have dramatically increased over the past three years.

A simple way to illustrate this point is by examining the recent trend in the cost of generating electrical energy from fossil fuels in MENA. This variable estimates the cost of turning a unit of fuel into a unit of energy, leaving out all the nonfuel overhead costs of energy production.

Figure 4.2 shows the trends in the costs of electrical energy generated from three fossil fuels in MENA, expressed in nominal U.S. dollars over the period January 2004–April 2008. These fuels are natural gas, gas oil,[39] and heavy fuel oil (HFO). They are assumed to be used in different technologies for power generation—namely, combined cycle plants for natural gas, gas turbines for gas oil, and steam turbines for HFO—to reflect general usage in MENA and elsewhere. Prices were provided by the World Bank's Development Research Group for the following fuels:

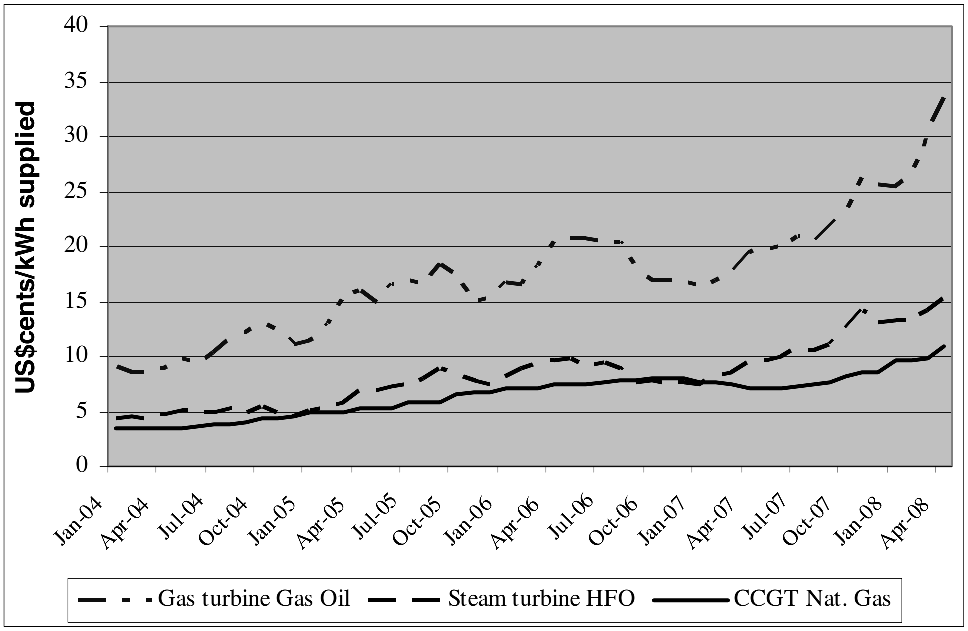
- Natural gas—average Europe border price
- Gas oil (diesel)—Middle East gulf gas oil (0.5 percent sulfur)
- HFO—Middle East gulf HFO (3.5 percent sulfur)

To make the results comparable with tariffs, the generating costs are transformed into the costs of energy supplied to power users by including an allowance of 15 percent[40] for technical losses in the power networks, which is within the range for MENA power systems. Hence Figure 4.2 actually shows the trends in the cost of energy supplied to power users from the three generation sources.

[39] Gas oil is termed diesel oil in some countries.

[40] This technical loss rate is itself quite high, compared with the benchmarked countries.

Figure 4.2 Costs of electrical energy from various fuels have increased in MENA since 2004 (in nominal US dollars)



Source: Computations based on historic fuel prices from the World Bank's Development Research Group.

The cost of electrical energy produced from gas oil shows the largest increase, from \$0.09/kWh supplied in January 2004 to \$0.33/kWh supplied in April 2008—an increase of 3.7 times. The cost of electrical energy produced from HFO increased from \$0.05/kWh to \$0.15/kWh supplied over the same period—an increase of 3 times. Likewise, the cost of electrical energy produced from natural gas increased from \$0.04/kWh to \$0.11/kWh supplied over the same period—an increase of 2.8 times. The trends shown in Figure 4.2 also indicate substantial volatility, with energy costs substantially rising and falling about the rising trend (more so for the two oil products than for natural gas). This sort of volatility in supply costs greatly complicates decisions about how much to increase electricity tariffs.

Combined cycle gas turbine (CCGT) plants fueled with natural gas constitute the main source of marginal power in MENA. This analysis indicates that energy rates should have been at least \$0.0.084/kWh to cover fuel costs at the average fourth quarter 2007 international gas prices (\$0.11/kWh to cover fuel costs at April 2008 international gas prices). Only Israel, Morocco, Tunisia, and the West Bank and Gaza met this standard.[41] Djibouti also met it, but it does not use this generation technology. The energy rates in all the other MENA countries in this assessment fell far short of this standard.

This forward-looking perspective characterizes the approach to estimating economic costs.[42] But this review of recent trends in energy costs also shows the high level of uncertainty involved

[41] The TOU energy charge was used for this assessment.
[42] Financial costs, on the other hand, are based on a backward-looking perspective, which helps explain the large differences between economic and financial costs when costs are changing.

in a forward-looking perspective. For example, Figure 4.2 shows that the energy cost from natural gas in CCGTs was fairly constant at around $0.07/kWh from early 2006 to mid-2007, and at that time there was little expectation that this energy cost would soon increase to $0.11/kWh.

The Impact of Electricity Prices on Electricity Demand in MENA

In principle, low electricity prices are expected to increase both electricity consumption and the growth rate in consumption (factoring out changes in income levels and assuming no supply constraints). The impact on demand of raising these prices depends on the long-run price elasticity of demand.

From the numerous case studies conducted in countries around the world,[43] a consensus has emerged of around –0.5 for this elasticity (see box below). This means that a 10 percent increase in energy prices would produce a 5 percent reduction (0.5 × 10 percent) in energy demand and, thus, a 4.5 percent increase in spending on energy.[44]

A cross-country log-log regression model was used to estimate the elasticities of different factors on energy consumption per capita. The ordinary least square (OLS) regression results on energy consumption per capita are presented in Table 4.4. The necessary data were found for only 15 countries worldwide. Electricity prices show a negative effect on energy consumption (elasticity of –0.53) that is statistically significant. Predictably, countries with large industrial sectors and fuel exports use more energy. The values of the coefficients, however, depend on which explanatory variables are included, so they should be used with caution.

Table 4.4 Explaining energy use by economic factors

	Energy consumption per capita
In GDP per capita	1.201** [7.75]
In share of industry	1.511* [3.35]
In share of agriculture	0.191 [1.65]
In fuel exports as % of gross domestic product (GDP)	0.232* [2.85]
In diesel price (egg index)	0.079 [0.39]
In electricity price for industry	-0.530** [3.48]
Constant	-18.112** [7.47]
Observations	15
R-squared	0.936

Source: Author's analysis for this paper using WDI database

Note: Absolute value of t statistics in brackets.

+ significant at 10%; * significant at 5%; ** significant at 1%.

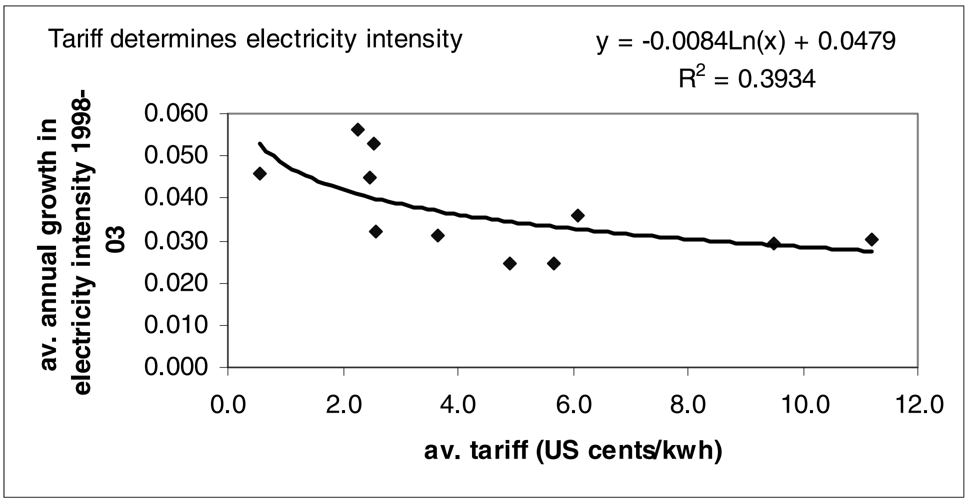
[43] Bohi 1981, Bohi et al. 1984, Dahl 1993, EIA 2006, Espey 2004, Taylor 1975 and 1977.

[44] This linear relationship between price and consumption is accurate only for small price changes. A curvilinear form should be used for assessing the impact of large prices changes on electricity consumption. A price-demand function of the type Q = a + b*logP could be used for residential consumers, and a Cobb-Douglas production function could be used for industrial consumers. If the price-demand elasticity is minus 0.5, a 50% price increase would reduce consumption by about 20% for both categories, and a 100%, price increase would reduce consumption by about 35% for residential consumers (not allowing for the effect on real income) and by about 30% for industrial consumers.

These cross-country elasticity estimates may not apply reliably to the MENA region for various reasons. One is that the studies cover hardly any countries in MENA, and therefore do not capture the specific characteristics of these economies. Another is that these elasticities are derived from long time series of data, implying that changes in prices also take place over a long period. This weakens their relevance to MENA to the extent that MENA countries face the need to make substantial price increases over short periods of time. A third reason is that the elasticities are averages for the whole electricity sector, whereas price adjustments should take account of the different demand characteristics found among categories of consumers.

For MENA, the relationship between price and demand is not clear. Figure 4.3 shows the correlation between electricity intensity growth for the period 1998 to 2003 and tariffs in 11 MENA[45]

Figure 4.3 Relationship between the annual change in electricity intensity and electricity tariffs, 1998–2003



Source: Appendix 4.1, 4.2 and WDI databse[46].

As the figure indicates, a clear correlation exists for these 11 countries. In other words, a combination of GDP and electricity tariffs has a good explanatory relationship with power demand.

This strong correlation could be obtained, however, only by removing Syria and Yemen from the analysis. Of the 13 countries, Syria and Yemen had the lowest and third-lowest per capita growth rates during the period under analysis. The reason is that both countries have a relatively important agricultural sector which in each case suffered from a 5% contraction in 2003, the reference year. The correlation between economic growth and power use therefore broke down. Unfortunately, one cannot avoid the fact that more historical data and empirical research are needed to come to a reliable conclusion on the effect of large increases in electricity prices on energy demand in MENA.

[45] Morocco, Tunisia, Lebanon, Jordan, Algeria, Oman, Bahrain, Egypt, Iran, Saudi Arabia Kuwait
[46] Average tariff is mean of residential tariff at 500 kWh/month (Appendix 4.1) and high voltage industrial tariff (Appendix 4.2)

Petroleum Products

This section analyses petroleum product prices in MENA countries against measures of economic costs. It first discusses the principle of using border prices for economic costs and it reviews the categories of products selected for this assessment. It then discusses three main questions:

- Which benchmarks should be used for the economic pricing of petroleum products, and how do MENA countries compare against those benchmarks?
- How can the countries deal with the volatility of fuel prices?
- What is the impact of prices on the demand for petroleum products?

Economic Costs Based on Border Prices

Because petroleum products are traded extensively and actively on international markets, the economic costs of these products for a country are based on the border prices for these products. This is true whether a country imports all its petroleum products or produces some from domestic refineries—and, if producing some domestically, whether the refinery's crude oil feedstock is locally produced or imported. This approach rests on the principle of opportunity cost, where more consumption means more imports or less exports. The direction of trade—import or export—only influences whether the costs of transporting the products should be deducted (in the case of exports) or added (in the case of imports) to the international market price to derive the country's economic costs for consumption.

Product Categories

A wide variety of petroleum products are produced, traded, and consumed—ranging from jet fuel and kerosene at the "light" end of the oil barrel to residual HFO at the "heavy" end. Many products are used industrially, but automotive diesel and gasoline are used in transport, and kerosene and light diesel oil are used in households.

Fuel prices for end users are tightly regulated in MENA countries. The justification given for this control is the important effect these prices have on the general level of domestic inflation and on household budgets—especially low-income households.

Because regulation of prices for petroleum products takes account of the type of user for each product, petroleum product prices in MENA are assessed against economic costs for the following three products:

- Kerosene—for the residential sector
- Diesel—for the transportation, commercial, and industrial sectors
- Gasoline—for the transportation sector

All prices and costs are expressed in US$ cents per liter for the fourth quarter of 2007.

The prices for petroleum products in the MENA region that are used in this assessment were obtained from various sources in these countries. Appendix 4.4 summarizes these prices.

Benchmark Values for MENA Petroleum Product Prices

Benchmarking of MENA petroleum product prices follows the same approach used for benchmarking MENA electricity prices. Hence the benchmark values for MENA petroleum product prices are the average of the pretax retail fuel prices for the same set of northern Mediterranean countries as for electricity, converted to U.S. dollars at the prevailing exchange rates. These countries have reasonably undistorted petroleum markets. Table 4.5 reports the average pre-tax retail prices for this benchmark group.[47]

Table 4.5 Benchmark values used for MENA retail prices of petroleum products[1]

Petroleum Product		
Light Fuel Oil for Households	**Automotive Diesel for Commercial Use**	**Premium Unleaded (95RON) gasoline**
(US$cents/litre)	(US$cents/litre)	(US$cents/litre)
84	89	80

Note: (1) Unweighted averages for France, Italy, Portugal, Spain, and Turkey of the pre-tax retail prices of petroleum products for the fourth quarter 2007.
Source: Computations based on retail prices given in Appendix 4.5.

Comparison of MENA Petroleum Product Prices against Benchmarks

Note that these benchmarks predate the massive rise in fuel prices since 2007. For countries that have not raised retail fuel prices in line with world prices, the 2008 levels of subsidization were higher than shown in Table 4.6.

Table 4.6 Average retail prices including taxes for petroleum product in MENA countries for fourth quarter of 2007, expressed in nominal U.S. dollars

	Petroleum Product			Proportion of Benchmark Price		
	Kerosene	**Diesel**	**Gasoline**	**Kerosene**	**Diesel**	**Gasoline**
	(US$cents/litre)	(US$cents/litre)	(US$cents/litre)			
Observations	18	20	17	17	20	17
Average price	46	46	53	58%	52%	66%

Source: Computations based on retail prices given in Appendix 4.4.

For the fourth quarter of 2007, it is possible to categorize MENA countries into three groups:

- Israel and the West Bank and Gaza had by far the highest product prices that exceeded the benchmark values for all three products.

[47] The pricing data for these countries are taken from the International Energy Agency's (IEA) quarterly publication of energy prices and taxation for the Organisation for Economic Co-operation and Development (OECD) countries and a few non-OECD countries (IEA 2008). Greece is excluded from this benchmark group because it does not report price data beyond 2004 in the IEA statistics for petroleum products. Unfortunately, the IEA statistics do not cover any MENA countries.

- Djibouti and Lebanon had prices at around the benchmark values for all three products.
- Jordan, Syria, and Tunisia had gasoline prices around the benchmark value, but their kerosene and diesel prices were below the benchmark values. Morocco's diesel price was around the benchmark value.
- The remaining twelve countries (Algeria, Bahrain, Egypt, Iran, Iraq, Kuwait, Libya, Oman, Qatar, Saudi Arabia, United Arab Emirates and Yemen) had product prices well below the benchmarks. These countries include all of MENA's major producers of crude oil, refined petroleum products, and natural gas. This trend indicates that these producers are distributing income from oil and gas production to the population partly through highly subsidized energy prices.

This grouping of countries by range of petroleum-product pricing closely matches the corresponding grouping of countries by ranges of electricity pricing. This suggests that where retail prices for petroleum products are highly subsidized, the prices charged for petroleum products used for electricity generation are also kept low to support low electricity prices. But there are some exceptions: Algeria and Yemen fall into the category of countries with the lowest fuel prices, and in the higher and middle categories for electricity, respectively; and Tunisia falls into the middle category for fuel prices and in the higher category for electricity.

Some countries have either raised prices or are considering doing so to provide relief from the subsidy burden at the current high international prices for petroleum products. Jordan announced in early February 2008 that fuel prices would be raised to lift fuel subsidies in that month.[48] Among these raises, the price of kerosene was increased from $0.45 per liter to $0.78 per liter, the price of diesel from $0.45 per liter to $0.73 per liter, and the price of gasoline from $0.62 per liter to $0.81 per liter (Hazaimeh 2008). Only the price of LPG remained subsidized to help low income households. Jordan has subsequently been increasing these product prices monthly in line with changes in the costs of these products to Jordan.

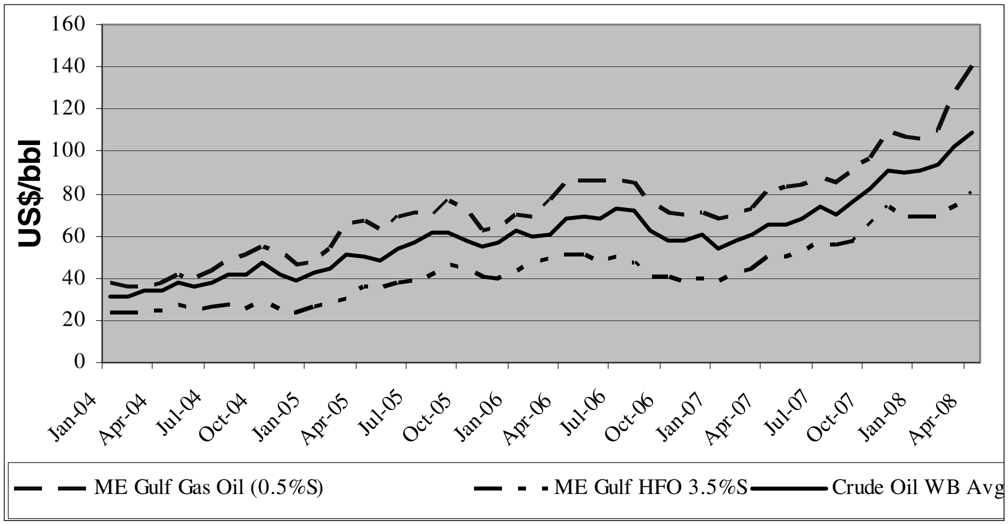
Coping with Volatile Fuel Prices

As with the pricing of electricity services, the pricing of petroleum products has had to face volatility around a steeply rising trend in international prices. This situation is illustrated in Figure 4.4, which shows trends in prices for the following products in nominal U.S. dollars for January 2004 to April 2008:

- Global average price for crude oil
- Middle East gulf price for gas oil (0.5 percent sulfur)
- Middle East gulf price for HFO (3.5 percent sulfur)

[48] *The Jordan Times*, "Fuel Subsidies Lifted," February 8, 2008.

Figure 4.4 Prices of selected petroleum products in MENA have followed increasing trend of global crude oil prices since 2004 (in nominal US dollars)



Source: World Bank's Development Research Group.

These trends show that Middle East prices for the two petroleum products closely follow the global price for crude oil. The price of gas oil has averaged about 20 percent more than the price of crude oil, and the price of HFO has averaged about 30 percent less than the price of crude oil.

To satisfy economic pricing principles, changes in the international prices of petroleum products should be passed through to users with little delay, because international prices account for a large proportion of the opportunity cost of consuming these products. This requires users to manage their exposures to the risks of such changes. Households—especially low-income ones—have little capacity for managing these risks other than changing their volumes of consumption. This explains the observation (from the analysis of product prices reported above) that kerosene—which is a critical consumable for poor households—is much more highly subsidized than other petroleum products in MENA countries. Options to manage the impact on the lowest-income groups are discussed in Chapter 5.

Impact of Petroleum Product Prices on Product Demand in MENA

As with electricity prices, changes in petroleum-product prices are in principle expected to produce inverse changes on the demand for petroleum products. But the income effect on product consumption in MENA appears to have been much stronger than the price effect.

A recently published study that examined the demand elasticities of petroleum products, for example, found relatively high income elasticities and low price elasticities in non-OECD countries that experienced high income growth or were oil exporting countries (Dargay et al. 2007). Long-run income elasticities of demand for petroleum products as a group (excluding residual fuel oil) were found to be near to unity, whereas long-run price elasticities of demand were found to be -0.17. Many MENA countries share one or both of these characteristics. Other MENA countries, however, do not fall into this group, and the category of countries to which they best correlate ("Other countries" in this study) was found to have a much lower income elasticity of 0.46, but the same long-run price elasticity of -0.17.

Options for Adjusting Pricing Practices in the Region

The preceding sections have established that over half the countries in MENA priced energy substantially below economic costs in the fourth quarter of 2007. Benchmarking MENA countries against six Mediterranean countries showed how far these prices were below economic costs, and hence that there was substantial scope for more efficient pricing and energy usage.

Regional data on income and price elasticities are not adequate for satisfactorily assessing the possible demand response if the countries were to adjust their price levels to economic cost. A reasonable preliminary conclusion is that economic energy pricing is highly supportive of improved energy efficiency, but it is not sufficient on its own.

The present section, therefore, outlines a possible approach to reforming energy prices in MENA that avoids the pitfall of trying to apply a single prescription to all MENA countries, so as to accommodate the variety of approaches to energy pricing found among them.

The approach rests on the hypothesis that MENA countries fall into three groups in terms of the economic performance of their energy prices:

- One group—Djibouti, Israel, Morocco, and the West Bank and Gaza—with energy prices near or above the economic costs of consumption and the financial costs of supply.
- A second group—Algeria, Jordan, Lebanon, Syria, Tunisia, and the United Arab Emirates (UAE)—with energy prices distinctly below the benchmarks but in the same order of magnitude.
- A third group—Bahrain, Egypt, Iran, Iraq, Kuwait, Libya, Oman, Qatar, Saudi Arabia and Yemen—with energy prices far below the benchmarks (and even one or two products priced below 10 percent of the benchmarks). These countries include most of MENA's major producers of crude oil, refined petroleum products, and natural gas.

This classification has significant implications for strategies to reform energy prices:

- In the first group of countries, the emphasis would be on reforming the structure of prices—such as TOU rates—rather than on large increases in price levels.
- In the second group, price reform would follow a balanced path involving both level and structure.
- In the third group, any price reform would focus on the price level, but reform price structures would co
- Implement efforts to improve efficiency.

- Reforming price levels in this context means raising the levels until they ultimately cover economic costs for each of the major user categories, where categories are defined by how their consumption patterns impose category-specific economic costs. It also means having a system in place that allows these prices to change in step with changes in economic costs, while protecting vulnerable users. An intermediate objective is for price levels to cover the financial costs of supply without an excessive amount of cross-subsidization among user groups.

The most common form of protection for lower-income households against high electricity prices is the rising block-tariff structure for residential users. This approach can help low-income households without oversubsidizing better-off users, provided that the concessional electricity rates are for modestly sized consumption blocks of around 100 kWh per month. Likewise, the common practice (in MENA and other regions) of pricing kerosene for household use at lower rates than other petroleum products, on the basis of energy content, reflects the importance of kerosene for low-income households. But a well-targeted means of providing this subsidy is needed to avoid the harmful practice—in economic, financial, and technical terms—of substituting kerosene for similar petroleum products such as light diesel and gasoline for transportation. For example, mixing a quarter liter of lubricant oil into a tank of kerosene is said to make a workable substitute for diesel.

Reforming the price structure in this context means introducing effective TOU rates for large users of electricity and introducing mechanisms that allow the pass-through of fuel costs to retail prices for electricity services and petroleum products. The latter provision should be subject to measures that limit—but do not eliminate—exposure to this sort of price uncertainty for users that cannot manage it efficiently. A critical issue is how the costs of providing this protection should be allocated among better-off energy users, and taxpayers in general, and how the protection should be provided. This is the subject of Chapter 5.

The pace of reform will be a critical consideration, especially for countries facing the need to raise price levels by a factor of two or more. Obviously, implementing a full reform of energy prices in the third group of countries is likely to be feasible only if carried out over many years, because otherwise the reforms would have unacceptable impacts on incomes.

The second group of countries has alternative feasible ways of raising prices—either in one step or in two or more steps. From an economic perspective, a single, immediate step is preferable in order to remove the deadweight loss quickly and to avoid the risk of government failure in implementation.

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Appendix 4.1: Electricity Prices Including Sales Taxes for Residential Usage in MENA Countries (in $ terms for fourth quarter 2007)

Country	Monthly consumption (kWh)							*Increase (times)*
	100	300	500	700	900	1100	1300	
Algeria	6.2	6.2	6.2	6.2	6.2	6.2	6.2	*1.0*
Bahrain	0.8	0.8	0.8	0.8	0.8	0.8	0.8	*1.0*
Djibouti	23.5	32.5	31.8	31.4	31.2	31.1	31.0	*1.3*
Egypt	1.4	1.9	2.5	3.0	3.5	4.0	4.4	*3.2*
Iran (Tehran)	0.9	1.2	3.2	6.3	8.4	8.4	8.4	*9.3*
Iraq	0.1	0.1	0.1	0.1	0.1	0.1	0.1	*1.0*
Israel	11.0	8.4	9.3	10.2	11.5	11.7	12.4	*1.1*
Jordan	4.4	6.2	7.5	8.7	9.3	9.7	10.0	*2.3*
Kuwait	0.8	0.8	0.8	0.8	0.8	0.8	0.8	*1.0*
Lebanon	2.3	3.2	4.6	5.5	6.1	6.4	6.7	*2.9*
Libya	2.0	2.0	2.0	2.0	2.0	2.0	2.0	*1.0*
Morocco	11.5	12.4	12.7	14.2	14.9	15.3	15.6	*1.4*
Oman	2.6	2.6	2.6	2.6	2.6	2.6	2.6	*1.0*
Qatar	2.2	2.2	2.2	2.2	2.2	2.2	2.2	*1.0*
Saudi Arabia	1.3	1.3	1.3	1.3	1.3	1.3	1.3	*1.0*
Syria	0.6	0.7	1.1	1.7	2.6	3.5	4.1	*7.1*
Tunisia	9.9	11.7	12.3	12.6	12.8	12.9	13.0	*1.3*
West Bank and Gaza	18.4	17.5	17.3	17.4	17.4	17.4	17.4	*0.9*
Yemen	7.0	4.5	4.8	5.1	6.2	6.9	7.3	*1.0*
Summary statistics for MENA								
Observations	19	19	19	19	19	19	19	*19*
Average	5.6	6.1	6.5	7.0	7.4	7.5	7.7	*2.1*
Median	2.3	2.6	3.2	5.1	6.1	6.2	6.2	*1.0*
Stand. dev.	6.4	7.8	7.6	7.5	7.5	7.5	7.5	*2.2*
Maximum	23.5	32.5	31.8	31.4	31.2	31.1	31.0	*9.3*
Minimum	0.6	0.7	0.7	0.8	0.8	0.8	0.8	*0.9*

Source websites for electricity tariffs in MENA countries:
- Algeria: Commission de Régulation de l'Electricité et du Gaz (CREG). Décision D/06-05/CD du 30 mai 2005 portant fixation des tarifs de l'électricité et du gaz
- Bahrain: Bahrain Electricity and Water Authority (http://www.mew.gov.bh/en/)
- Djibouti: Electricité de Djibouti (http://www.edd.dj/?lnk=tarif)
- Egypt: Egypt Electricity Holding Company (EEHC) (http://www.egelec.com/)
- Iran (Tehran): Ministry of Energy (http://tariff.moe.org.ir/)
- Iraq: Ministry of Energy
- Israel: Public Utility Authority
- Jordan: National Electric Power Company (NEPCO) (http://www.nepco.com.jo/english_etariff.html)
- Kuwait: Ministry of Oil (MOO) (http://www.moo.gov.kw/facts/en)
- Lebanon: Electricité Du Liban (http://www.edl.gov.lb/AboutEDL.htm#5)
- Libya: General Electricity Company of Libya (GECOL) (http://www.gecol.ly/en/index.html)
- Morocco: Office National de l'Electricité (www.one.org.ma)
- Oman: Muscat Electricity Distribution Company SAOC (http://www.medcoman.com/Tariffs.htm#Tariffs:)
- Qatar: General Electricity and Water Corporation (Kahramaa) (http://www.kahramaa.com.qa/NR/exeres/97661B7E A5E4-4AA7-8750-130895C47D1A.htm)
- Saudi Arabia: Ministry of Water and Electricity (http://www.mowe.gov.sa)
- Syria: Ministry of Electricity (http://webfea-lb.fea.aub.edu.lb/fea/research/erg/web/Policy%20Paper%20Syria.pdf)
- Tunisia: Tunisian Society of Electricity and Gas (STEG) (www.steg.com.tn)
- West Bank & Gaza: Individual power utilities - no websites
- Yemen: Public Electricity Corporation (PEC). "Growth of Tariff Electricity and Service fees 1997-2008" - no website

Appendix 4.2: Electricity Prices Including Sales Taxes for Industrial Usage in MENA Countries (in $ terms for fourth quarter 2007)

Country	Maximum Demand charge ($/kW/month)	Energy (cents/kWh)				*Ratio peak to low rates*	*Ratio residential to industrial rates*
		Flat rate	TOU peak	TOU medium	TOU low		
Algeria	13.0		8.2	1.7	0.7	*11.2*	
Bahrain		4.4					*0.19*
Djibouti	3.7	19.7					*1.60*
Egypt		2.5					*1.20*
Iran (Tehran)			5.4	1.6	0.4	*13.2*	
Iraq		1.6					*0.05*
Israel			19.1	11.5	3.7	*5.2*	
Jordan	3.4		6.8		4.7	*1.4*	*1.51*
Kuwait		0.4					*2.00*
Lebanon		7.6					*0.73*
Libya		2.5					*0.81*
Morocco	6.1		13.8	8.8	6.4	*2.2*	
Oman		4.7					*0.56*
Qatar		1.9					*1.14*
Saudi Arabia		3.2					*0.42*
Syria			12.3	8.3	6.0	*2.0*	
Tunisia	2.9		9.4	6.5	4.1	*2.3*	
West Bank and Gaza		10.8					*1.61*
Yemen		8.7					*0.59*
Summary statistics for MENA							
Observations	5	12	7	6	7	*7*	*13*
Average	5.8	5.7	10.7	6.4	3.7	*5.4*	*1.0*
Median	3.7	3.8	9.4	7.4	4.1	*2.3*	*0.8*
Stand. dev.	3.8	5.2	4.4	3.7	2.2	*4.5*	*0.6*
Maximum	13.0	19.7	19.1	11.5	6.4	*13.2*	*2.0*
Minimum	2.9	0.4	5.4	1.6	0.4	*1.4*	*0.1*

Source: See Appendix 4.1

Appendix 4.3: Electricity Prices Including Sales Taxes for Residential Usage in Benchmark Countries (in $ terms for fourth quarter 2007)

Country	Monthly consumption (kWh)							*Increase (times)*
	100	300	500	700	900	1100	1300	
France	22.1	18.2	17.2	17.8	18.1	18.2	18.3	*0.8*
Greece	14.3	15.2	17.1	20.9	22.2	23.6	24.0	*1.7*
Italy	15.6	21.8	23.1	22.9	22.7	22.7	22.6	*1.4*
Spain	9.9	15.6	15.4	15.2	15.1	15.0	15.0	*1.5*
Portugal	19.0	18.8	18.7	18.1	18.3	18.6	18.3	*1.0*
Turkey	12.0	12.0	12.0	12.0	12.0	12.0	12.0	*1.0*
Summary statistics for benchmark countries								
Observations	6	6	6	6	6	6	6	*6*
Average	15.5	16.9	17.3	17.8	18.1	18.4	18.4	*1.2*
Median	15.0	16.9	17.2	18.0	18.2	18.4	18.3	*1.2*
Stand. dev.	4.1	3.1	3.4	3.5	3.7	4.0	4.1	*0.3*
Maximum	22.1	21.8	23.1	22.9	22.7	23.6	24.0	*1.7*
Minimum	9.9	12.0	12.0	12.0	12.0	12.0	12.0	*0.8*

Electricity prices including sales taxes for industrial usage in benchmark countries (in $ terms for fourth quarter 2007)

Country	MD charge ($/kW/ month)	Energy (cents/kWh)				*Ratio peak to low rates*
		Flat rate	TOU peak	TOU medium	TOU low	
France	2.4		20.1	10.0	6.2	2.4
Greece	13.8		8.6	6.0	4.4	13.8
Italy	3.0		21.1	14.8	10.6	3.0
Spain	4.7		33.1	11.4	4.9	4.7
Portugal	1.9		31.1	17.7	12.4	1.9
Turkey	7.4		13.9	7.9	3.5	7.4
Summary statistics for benchmark countries						
Observations	6		6	6	6	*6*
Average	5.5		21.3	11.3	7.0	5.5
Median	3.9		20.6	10.7	5.6	3.9
Stand. dev.	4.1		8.7	4.0	3.3	4.1
Maximum	13.8		33.1	17.7	12.4	13.8
Minimum	1.9		8.6	6.0	3.5	1.9

Source websites for electricity tariffs in benchmark countries:
- France: Electricité de France (EDF) (http://particuliers.edf.fr/index)
- Greece: Public Power Corporation (PPC) (http://www.dei.gr/Default.aspx?id=3536&nt=19&lang=2)
- Italy: Ente Nazionale per l'Energia Elettrica (ENEL) (http://www.enel.it/sportello_online/elettricita/tariffe_altri_usi/mercato_vincolato/uda_mt/MTA3/)
- Portugal: Energias de Portugal (EDP) (http://www.edp.pt/EDPI/Internet/EN/Group/Customers/dual_tariff/dual_tariff.htm#) and (http://www.edp.pt/EDPI/Internet/PT/Group/Clients/free_market/Prices/default.htm)
- Spain: Boletín Oficial del Estado (BOE) (http://www.boe.es/boe/dias/2007/12/29/pdfs/A53781-53805.pdf) and Iberdrola (https://www.iberdrola.es/02sica/clientesovc/iberdrola?IDPAG=ENTARIFAS_CUADRO_07)
- Turkey: Turkish Electricity Distribution Company (TEDAS) (http://www.tedas.gov.tr/17,Tarifeler_Index.html)

Appendix 4.4: Retail Petroleum Product Prices Including Sales Taxes in MENA (in $ terms for fourth quarter 2007)

MENA countries	Petroleum Product Kerosene (UScents/liter)	Diesel (UScents/liter)	Gasoline (UScents/liter)	Proportion of Benchmark Price Kerosene	Diesel	Gasoline
Algeria		19	31		21%	38%
Bahrain	7	19	21	8%	21%	26%
Djibouti	84	86		100%	96%	
Egypt	13	13	16	16%	15%	20%
Iran	2	2	11		2.0%	13%
Iraq	12	33	33	14.7%	37.1%	41.1%
Israel	183	149	154	218%	168%	193%
Jordan	43	42	87	52%	48%	108%
Kuwait	19	19	21	23%	22%	26%
Lebanon	82	82	78	98%	93%	97%
Libya	5	10	13	6%	11%	16%
Morocco		92			104%	
Oman	31	27	30	37%	30%	37%
Qatar	11	19	19	13%	22%	24%
Saudi Arabia	12	7		14%	8%	
Syria	44	14	72	53%	16%	90%
Tunisia	52	68	87	62%	77%	109%
United Arab Emirates	27	62	45	32%	70%	56%
West Bank & Gaza	183	134	154	218%	151%	193%
Yemen	18	18	30	21%	20%	38%
Summary statistics						
Observations	18	20	17	17	20	17
Average	46	46	53	58%	52%	66%
Median	23	23	31	32%	26%	38%
Stand.Dev.	54	42	45	65%	47%	56%
Maximum	183	149	154	218%	168%	193%
Minimum	1.8	1.8	10.8	6.0%	2.0%	13.5%

Source: World Bank country studies

Appendix 4.5: Benchmark Countries Prices Excluding Sales Taxes (in $ terms for fourth quarter 2007)

Benchmark Country	**Petroleum Product** **Light Fuel Oil for Households**	**Automotive Diesel for Commercial Use**	**Premium Unleaded (95RON) gasoline**
	(USDcents/liter)	(USDcents/liter)	(USDcents/liter)
France	80	80	71
Italy	85	89	80
Portugal	84	85	76
Spain	75	84	76
Turkey	95	105	97
Summary statistics			
Observations	5	5	5
Average (1)	**84**	**89**	**80**
Median	84	85	76
Stand.Dev.	6	9	9
Maximum	95	105	97
Minimum	75	80	71
Tax rate - average of ex-tax price	63%	75%	145%

Source: IEA 2008.

Note: 1. Benchmark prices.

Chapter 5: Facilitating Energy and Subsidy Reforms for Energy Efficiency through Social Protection

We learned in the last chapter that reforming energy pricing and subsidies can improve energy efficiency and, conversely, that energy efficiency can make such reforms easier to undertake. This chapter takes that argument a step further by making two key points: first, for social and political reasons, price and subsidy reform requires effective social protection, and; second, integrating energy efficiency into social-protection programs can facilitate the implementation of energy-price reform.

This chapter examines social protection in just one of its aspects: its connection to energy prices. Of course, social-protection programs have wider aims: to reduce poverty and vulnerability, and to help people deal with unemployment, disability, old age, economic crises, illness, and so on. But this chapter focuses on the measures intended to (a) redistribute resources to those most vulnerable to increases in energy prices and (b) help households deal with energy-price volatility.

The first section summarizes principles for designing and implementing social safety nets to accompany energy-price reforms. The second discusses lessons learned from international experience with reference to several countries of the MENA region.

By exploring the options open to governments wishing to protect vulnerable populations from the short-term hardships caused by otherwise desirable reforms, we can improve the chances that reforms of energy prices and subsidies will be successful.

Why is Social Protection Relevant to Energy Price and Subsidy Reform?

Raising fuel prices brings energy efficiency, economic gains and fiscal savings—but also substantial political and social risks.

MENA's socio-political environment for reform is complex. Citizens often judge governments' performance in terms of their ability to guarantee low prices for basic commodities. There may be several reasons for this:

- For oil-rich countries, commodity subsidies are an administratively simple way of distributing wealth.
- Governments in MENA are less accountable to the public than in other regions with similar levels of income (World Bank 2003). In this context, commodity subsidies can be important as a sign to citizens that governments are responsive to their needs. There is

statistical evidence that countries with low levels of political accountability tend to subsidize urban populations (Ades and Glaeser 1995).

- Subsidies might be seen as a way of sharing the benefits of growth with marginalized groups. In MENA, the majority of countries have significant rural-urban development gaps and lagging regions. The region's very challenging demographic profile is another element that makes reforms risky and difficult. MENA has an unusually high proportion of young people – almost half of the population is below the age of 25 – with a large number of unemployed or underemployed qualified youths. In spite of significant progress, the societal gap between women and men is still significant: a literacy gap remains, and only a fraction of educated women enter the labor market. Cultural traditions preclude certain vulnerable groups from accessing social safety net measures (for example, monetary compensation).

Whatever the cause, a long history of state intervention and paternalism in the economy throughout the region has built popular expectation that governments should manage prices and provide social support (in particular subsidized housing, cooking fuels and public transport for the lower income groups). The challenge for governments when allowing prices to rise is to avoid a serious backlash. In May 2004, demonstrations against fuel-price increases in Lebanon that were repressed by the troops sparked riots throughout Beirut's southern suburbs, leaving the Labor Ministry in flames (*New York Times* 2004). In Algeria in January 2005 fuel-price increases led to riots in several towns (*BBC News* 2005). Thirty-six people died in similar riots in Yemen in July 2005 (Whitaker 2005).

Such strife is not unique to the region. In 2008, more than 35 developing countries—among them Egypt, India, Mexico, Yemen, and many African countries—experienced protests and riots over commodity prices. The spring of 2008 saw street protests over fuel prices in many European Union (EU) member states.

If subsidized energy prices are unsustainable, what can be done to limit the social and political effects of removing subsidies letting prices rise? The answer lies in well-designed programs of social protection.

Morocco provides a good illustration of the complexity of the issues (ESMAP/World Bank 2008). What are the lessons from its experience?

- First, income groups differ greatly in their fuel consumption patterns. Lower-income groups spend a higher proportion of their energy budget on cooking fuels, for example, and less on electricity and private transportation.

- Second, one must understand how the interests of different groups differ. There are significant disparities between the consumption patterns of the rural and urban poor. The most vocal group opposing the removal of subsidies may be the urban middle class, either because it captures most of the benefits of subsidies, or because it seizes the occasion of subsidy removal to voice opposition to the government.

- Third, any change has wider ramifications. Increasing the price of liquid fuels that households use for cooking and lighting would likely increase the use of charcoal and wood as substitutes. But the use of these inferior fuels would have adverse impacts, particularly on women and girls, who carry the loads and inhale the smoke. The additional time needed to collect wood and to cook with less efficient fuels would reduce the time available to earn incomes and would affect households' already tight budgets. Also, the environmental impact on forests and rangelands would be extensive. Many poor households would react to an increase in the price of liquid fuels by buying smaller cylinders, which are relatively more expensive; any subsequent reduction in the proportion of cooked food or boiled water would significantly impact nutritional intake and morbidity, especially among women and young children.

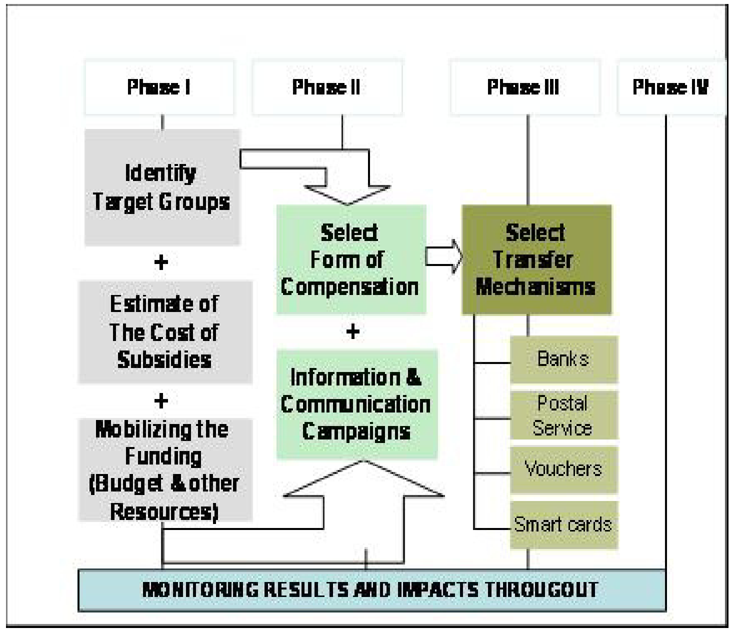
The critical aims of social protection, therefore, are to:

- Facilitate effective reforms of energy prices, while mitigating undesirable side-effects
- Protect poor households' welfare from energy-price fluctuations
- Correct the inequities caused by prior subsidy schemes, which have largely benefited the rich (as documented in chapter 3), and
- Prevent the sorts of political and social backlash that have doomed previous efforts to reorient subsidies and set energy prices at levels closer to their true cost.
- A schematic representation of the four phases necessary to prepare for an energy-related social-protection program is given in Figure 5.1.

Assessing the Potential Impact of Reform and Identifying Vulnerable Groups

Before designing the social safety net that will accompany energy-price and subsidy reform, one must ask which fuel users would be the most affected and by how much (Figure 5.1). It is equally important to know what share of the current subsidy actually reaches the poor.

Answers might be defined by geographical area (rural versus urban, various climatic zones) or by the nature of vulnerability (female-headed households, small businesses, fuel-dependent farmers, and so on).



It is also important to distinguish those who are poor *now* from those who are at risk of becoming poor as a result of price hikes, as the choice of mitigation measures will differ. The poor may need compensatory payments; the vulnerable may need improved livelihoods to avoid falling into poverty.

Relevant, current data are needed to properly identify target groups. With the data in hand, various sources and methodologies can be used for the targeting. Household surveys usually provide the most comprehensive sources of information, provided they include the right energy-related questions[49]—but such surveys are carried out only every few years. Poverty and social impact analyses, such as those conducted by the World Bank, and rapid appraisals complement data from household surveys. Poverty maps that incorporate data from geographical information systems are increasingly used to identify regions at risk.

Several methods of targeting social-protection programs can be combined.

- *Means testing or proxy-means testing (PMT).* Eligibility is based on income, assessed directly or through an indicator (or proxy) that is closely related to income. This methodology was used by Indonesia in 2005.
- *Geographic targeting.* This concentrates extra social expenditures on households living in the poorest areas. This method was used by Mali in 2000 as it implemented its first poverty-reduction strategy and applied the proceeds from a debt-relief program.
- *Community targeting*. Eligibility is determined by community actors, such as teachers or community leaders, deemed to have good knowledge of households' economic welfare.
- *Sector targeting*. Beneficiaries might include transport operators, farmers, and fishermen. Part of this methodology was recently used by Jordan (see chapter 7 for the context).

The next question is how price reforms and the lifting of subsidies are likely to affect vulnerable groups and economic activity. Models that combine partial equilibrium simulations with household-survey data sets are an effective tool to predict the impact of price shocks on poor households, inflation, fiscal balances, balance of payments, and sector growth. Such an approach

[49] For a comprehensive discussion of these energy questions, see ESMAP 2007.

was adopted by Indonesia in 2004–5; similarly, partial equilibrium models are being used in Morocco and Tunisia to assess how to proceed with energy-price reform.

Once vulnerable groups are identified and the extent of their vulnerability assessed, it becomes possible to compute the cost, complexity, and launch time of mitigation options.

Social-protection programs can entail major administrative costs. Well-run cash-transfer programs cost 5–10 percent of benefits. Avoiding fixed costs wherever possible and eliminating duplicate programs can help keep costs down. Using existing institutional (and physical) infrastructure and integrating the delivery mechanism with an existing social safety net lowers costs and speeds implementation.

In Indonesia, timeliness in transferring compensation payments to households was essential in order to maintain the government's credibility. Reaching more than 4 million households was a daunting task. Using the post office network to deliver transfers proved the least costly option. In Chile, household information on file with the social security system avoided the cost of new surveys (ESMAP/World Bank 2008). The UK government in 2008 provided energy utilities with information from existing social assistance databases to facilitate the targeting of tariff discounts. Lessons from other international experience are reviewed in box 5.1.

The proper sequencing of reform and mitigation measures is essential. A year of preparation is usually necessary to do the analytical work, select the appropriate measures, and prepare the implementation plan, including a public information campaign. However, moving too slowly has its own dangers, notably the risk of "policy fatigue." Ecuador initiated fuel-price reforms in 1998. Before the mitigating cash-transfer program reached 50 percent of households, the government was obliged to reestablish fuel-price subsidies following street protests in July 1999 (Ibid.). The rapid announcement and implementation of compensatory measures for the spring 2008 price increases in Jordan and Egypt might prove more successful.

Box 5.1 Learning from experience when planning reforms

A recent review of fuel-subsidy reform efforts in eight middle-income countries—Brazil, Chile, Colombia, Indonesia, Turkey, Malaysia, India, and China—yielded valuable lessons.

Successful reform of fuel subsidies depends on the implementation of an efficient social-protection mechanism that compensates low-income households. Existing safety nets and social-protection programs should be assessed before designing new schemes, as existing programs may be used until a long-term alternative can be implemented.

Compensation paid following the elimination of subsidies must be carefully targeted. The same applies to any remaining subsidies. Leakages to the non-poor can never be totally eliminated, but targeting is needed to minimize leakages and ensure that the poor are compensated for a reasonable portion of their losses. Targeted cash transfers are usually the best compensatory mechanism—so long as their administrative implementation is a practical possibility. As a transitional measure, until the targeting system is ready, the government can offer a flat cash transfer to all consumers to kick-start the reform. It is more efficient to embed price and subsidy reform in a plan that comprehensively addresses social protection than to proceed on a sector basis.

It is essential to prepare reforms well, and to back them up with rigorous analysis. Because reforms take time, governments are well advised to equip themselves with relevant analytical tools with which to monitor results and adjust key measures in the compensation package. Delinking political processes from price setting facilitates successful reform design and convinces those affected that reform is necessary and will be implemented fairly. The merits and content of measures must be communicated clearly, through a broad publicity campaign.

Implementation timing is important. A phased reduction of existing subsidies will often be necessary, but there is a risk of "policy fatigue" if the reform period lasts too long. When Indonesia eliminated fuel-price subsidies in 2005, in the first phase the government provided cash transfers to the most affected households to offset the price increase. In the second phase, the government deployed educational and health programs targeted to poorer households and was able to finance these programs through the savings from energy subsidies. The experience of Indonesia, possibly the richest experience to-date, is reviewed more comprehensively in chapter 7.

Source: ESMAP/World Bank 2008

Selecting Compensation Measures

Cash transfers from the government to targeted consumers may be direct, indirect, or conditional.

- *Direct transfers* take the form of cash grants to the household.
- *Indirect transfers* may come as vouchers for purchases of commodities or services at a subsidized price.
- *Conditional transfers* oblige the recipient to take certain actions beneficial to the household but not necessarily related to energy consumption, such as sending children to school.

Cash transfers have several advantages. They allow consumers to adjust consumption to prices. Their cost to the government budget is known with certainty. And they can be targeted toward poor households or other groups. They also have drawbacks—their value may erode quickly in times of high inflation, and they may be prone to corruption.

Salary and pension increases for certain target groups are another option to offset the removal of energy subsidies. Jordan included this measure, applied to certain categories of civil servants, in the social-safety-net package that accompanied the removal of fuel subsidies in February 2008. Egypt awarded a 30 percent increase in basic pay to civil servants just before announcing a fuel-price increase. However, these programs may not be serving the needs of even poorer households depending on informal sector incomes.

Selecting Transfer Mechanisms

Administrative simplicity is an important criterion for selecting the mechanism used to transfer social-protection payments. It is preferable to use existing institutional systems than newly created, untested ones.

Various mechanisms for cash transfers have been used successfully. Postal checks were used in Indonesia, where few of the poorer households have bank accounts; bank checks were used in Jordan, where all households have bank accounts. Vouchers may be distributed at certain government or government-licensed offices; Syria, for example, has long had a universal commodity coupon system. Fuel or energy vouchers are more difficult to administer because they require timely compensation of the fuel retailer or service provider willing to sell the product or service at a discounted price. They also maintain a two-tier price system, with the risk that supplies earmarked for sale at lower prices are diverted to a more profitable open market or that a secondary (speculative) market develops, as recently seen in China.

There have been attempts to limit energy-price subsidies by offering the lower price to just one class of consumers. In May 2008, the British government announced plans to provide electricity and gas companies with lists of people receiving social benefits so the latter could receive preferential tariffs. The success of this approach will depend on the government's ability to maintain the eligibility roster and energy suppliers' ability to enforce differential tariffs. Also, it is obviously easier to apply such a practice to electricity and piped gas than to liquid fuels. Unless strictly monitored and enforced, differential tariffs are likely to lead to informal markets, fuel smuggling and adulteration, and illegal connection and bill collections.

Smart cards have proven to be an effective means of transferring targeted subsidies. Malaysia's experience is quite instructive. The cards can be used to transfer direct or indirect subsidies. They may be prepaid, or accounts may be settled periodically—for example, at the end of each month. The smart card includes the recipient's identification and the allotted quota of a specific good. Recipients who exceed the allotted quota are charged for the excess amount at the market price (ESMAP/World Bank 2008).

Energy Efficiency as a Form of Social Protection

Social programs, including energy efficiency, can be viewed as a transfer mechanism. Social programs are based on the assumption that if vulnerable households have to increase their energy expenditures, they will diminish their expenditures on other basic needs. Unlike cash or income transfers, which have short-term impacts, social programs provide indirect compensation aimed at improving long-term household welfare. Examples of such programs include lower bus fares in Malaysia; support for education, health, transport, and rural electricity in Ghana; higher public sector wages and pension payments in Jordan; and food subsidies in Sri Lanka (Ibid.).

Because it saves households money, energy efficiency can be viewed as a form of social protection, one that imposes no fiscal costs. Brazil, Argentina, and South Africa are among the few countries that have experimented with integrating energy efficiency into social protection.[50]

In many poor urban neighborhoods, households often cannot manage to pay their electricity bills regularly—they fall into arrears and get disconnected. Utility services are then provided by "entrepreneurs" who install unsafe connections illegally and often charge more than the utility. One of the challenges for private utilities operating under concession contracts is to "re-legalize" these poor customers. Energy efficiency programs can help.

In northeast Brazil, COELBA (Companhia de Electricidade do Estado da Bahia), a private electricity-distribution utility responsible for more than four million customers (of whom 60 percent are poor), has developed an innovative approach using energy efficiency to regularize

[50] Sources for this section include ESMAP (2007) for Argentina and Brazil and, for South Africa, interviews conducted by D. Lallement in 2002.

poor clients. It selects "extension agents" among community members, trains them in energy efficiency diagnostics, and dispatches them from home to home to explain low-cost measures to save energy while maintaining the same level of household welfare. Measures commonly advocated include painting the walls white to enhance natural light, changing the rubber seal on refrigerator doors, installing ceiling insulation, and improving ventilation to limit the need for electric fans. With these energy efficiency measures—and therefore energy savings—COELBA has been able to convince residents of the merits of meters (which allow them to monitor their own consumption) and of reconnecting to the utility's grid. COELBA has been able to expand its services to new customers from energy saved, without increasing its purchase of electricity from generators. The lesson from this experience is that, with energy efficiency measures, it is possible to improve social welfare *and* utility performance.

In Argentina, EDENOR (Empresa Distribuidora y Comercializadora Norte), a private electricity-distribution utility in Buenos Aires, has used prepaid meters to integrate poor customers into its regular client base. The results of a survey carried out among a sample of clients highlighted the results. Residents recognized that prepaid meters helped them improve their management of household energy use, increase energy efficiency, and save money (by reducing energy expenditures).

In a slum area of Cape Town, South Africa, consumers explained that prepaid meters permit "self-rationing," allowing them to conserve power for essential uses until they can afford to recharge their meter—without incurring service interruption. Households become efficient consumers: they organize their tasks around times when electricity is most needed by all members of the family, such as ironing and school work.

MENA's Experience with Social Safety Nets Linked to Energy-Price and Subsidy Reforms

Several MENA countries have many of the right ingredients for successful energy-price and subsidy reforms, but few have combined them systematically. Drawing on Blanchard (2008), this section reviews five countries—Egypt, Iran, Jordan, Morocco, and Tunisia—where the current situation is still very much a work-in-progress. It compares the context of reform and the pre-reform analytical work. It does not compare the implementation of reform, as only one country—Jordan—has proceeded with full elimination of fuel subsidies. Jordan's implementation experience, which began in early 2008, is compared in chapter 7 with Indonesia's, recognized as a best-practice case.

The Context of Price and Subsidy Reforms

The five countries represent very different contexts, as can be expected given their different resource endowments and economies. They had four reasons to consider eliminating fuel-energy subsidies: the worsening fiscal burden of subsidies, the regressive characteristics of subsidies, the risk to the balance of payments, and supply constraints (table 5.1). All four factors weighed on Iran and Morocco, and fiscal cost was a common factor for all five countries; In Jordan, for example, the increasing fiscal burden of subsidies increased from $60 million in 2002 to $749 million in 2005 (see Figure 7.7).

Egypt began raising fuel prices in 2004 after a period of seven years (1997–2004), during which all the gains from price increases implemented in the 1980s and 1990s were reversed, a fiscal blow that was aggravated by the depreciation of the exchange rate in 2003–4.

In Iran, the fiscal cost of subsidies, which reached 11 percent in 2005, was also the main cause for considering reform. In addition, Iran was concerned with (a) the regressive distribution of benefits (with an estimate that subsidies benefited the highest income deciles 12 times more than the lowest), and (b) the fact that the nation was consuming more fuel than it could refine, resulting in soaring imports of refined products.

In Morocco and Tunisia, the main concern was to limit the weight of subsidies on the government's budget. Morocco was also concerned about subsidies' impact on (a) the balance of payments, and (b) equity (given the importance of LPG as the main cooking fuel across all income groups).

Planning for Reforms

Each of the five countries used a comprehensive set of analytical tools to prepare for the reforms. Some participated in analytical efforts led by the World Bank and the International Monetary Fund. This analysis covered all or some of the five sets of issues needed to design a reform package, as described earlier in this chapter and summarized in table 5.1.

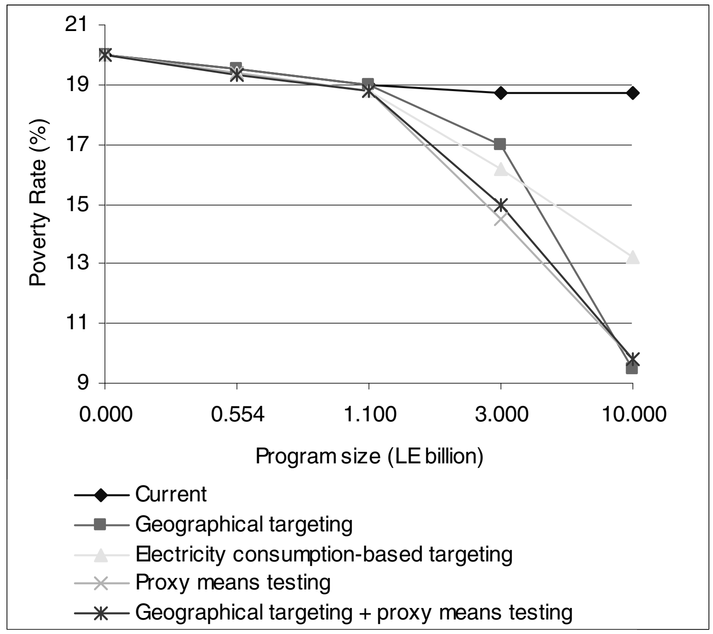
Table 5.1 Planning for reforms in five case-study countries

	Egypt	Iran	Jordan	Morocco	Tunisia
Identifying target groups and energy consumption patterns	✓		✓	✓	
Modeling economic and social impacts	✓	✓	✓	✓	In process
Identifying compensation measures	✓	✓	✓	✓	✓
Estimating the cost of compensation			✓		In process
Identifying implementation mechanisms	✓	✓	✓		

Source: Blanchard 2008.

Identifying target groups and consumption patterns

Figure 5.2 Egypt: effects of various transfer mechanisms on poverty rates



Source: World Bank staff calculation based on CAPMAS undated.

In Egypt, government cash-transfer programs have been less effective than private transfers (within household networks) and food subsidies, largely because of their limited budgets and coverage. In 2006 the government and the World Bank analyzed options for improved targeting and compensation levels, using several methodologies—geographical targeting, electricity consumption-based targeting, and proxy means testing. The results (summarized in figure 5.3) indicate that:

- The choice of targeting approach is crucial. The least efficient approach offered a 2 percent reduction in poverty, and the most efficient approach a 12 percent reduction.
- For programs with a budget in excess of 1 billion Egyptian pounds (LE), geographical targeting, targeting through electricity consumption, and proxy means testing all outperform the current targeting system.

In Jordan, potential recipients of compensation for the 2008 price increases were targeted using a database that identifies households by income levels. After an evaluation of the effectiveness of the targeting, the IMF suggested improving the identification of the neediest households using proxy means testing. Energy-consumption patterns of income groups—in terms of the share of household budgets spent on different sources of energy—are well documented (IMF, 2006a). Such information helps identify which income group to target, the potential size of the compensation, and the most important fuel types for vulnerable households.

In Morocco, 14 percent of the population is below the poverty line, with an additional large vulnerable population with incomes of 100 to 150 percent of the poverty line (box 5.2). Poverty maps can be used to determine the target groups for compensation payments in rural areas (Litvack 2007), where income distribution is fairly homogenous. In urban areas, however, income distribution is more heterogeneous, and it would be necessary to supplement poverty maps with survey data to reach the urban poor without unacceptable inclusion and exclusion errors.

Box 5.2 The devil in the details: the context for energy-price reforms in Morocco

In Morocco, liquefied petroleum gas (LPG) remains heavily subsidized at 50 percent below market price.

Conceived to discourage the use of wood and charcoal for environmental reasons, the subsidy is applied across-the-board—all users, rich or poor, pay the same price. It is administered by the government, which directly compensates fuel suppliers for the difference between the market and fixed price of fuel.

The fiscal burden of the subsidy is increasingly difficult to bear, particularly as it reduces funds that could be available for social programs and economic development. But LPG is the cooking fuel used by nearly all households, and it is the most efficient cooking fuels. Even with electrification rates ranging from 80 percent to almost 100 percent, for the poor, LPG is a large share of energy costs, which represent 8–9 percent of household expenditure on average. Recent surveys indicate that, if LPG prices increased to market levels, the most vulnerable households would switch back to charcoal, wood, or kerosene. So, if the Moroccan government were to reduce LPG subsidies, some form of compensatory social protection would be needed to make the reform politically viable and socially acceptable.

Some 14 percent of Morocco's population lives below the poverty line, with a large "vulnerable" population living just above the line. Rural poverty is wider and deeper than urban poverty and quite different in character; for example, most unemployment occurs in cities, but rural families are exposed to the vagaries of agricultural production.

Recently, the Moroccan government has moved social protection in new directions. As part of this shift, the government is now trying to move away from across-the-board price subsidies toward targeted, direct, income-support measures and pro-poor services.

Source: ESMAP/World Bank 2008.

Modeling economic and social impacts

In principle, two main economic effects from subsidy removal should be modeled during the planning phase: (a) the impact on price, and (b) the impact on economic activity. The main social impact to be modeled is that of subsidy removal on the cost of living for different income groups.

To assess the impact of subsidy removal on price levels and on the sectors of the economy, the Planning Ministry of Morocco used the Leontief framework and a linear model of price formation integrating 20 sectors of the input-output table of Morocco (table 5.2). The model was calibrated using 2003 data on inputs, wages and capital, taxes and subsides on products, margins, and external trade taxes. The model showed that a 62 percent aggregated growth of oil-products price in the refining sector would lead to an overall price increase of 7.7 percent. The overall price increase would be equivalent to 12 percent of the oil products' price increase. The transport sector would be the most affected, with a price adjustment of 16 percent; the least affected would be agriculture at 4 percent.

Table 5.2 Morocco: Simulation of price adjustments following elimination of oil-product subsidy

Sector	%
Oil refining and other	62
Transport	16
Fisheries	14
Other manufacturing	14
Extractive	12
Electricity and water	10
Construction	10
Chemicals	8
Food	6
Mechanical, steel, and electrical	6
Commerce and repairs	6
Public administration and security	6
Textiles and leather	5
Hotels and restaurants	4
Agriculture	4

Source: World Bank staff calculations

For Egypt, a computable general equilibrium (CGE) model (World Bank 2005) estimated the impact of a 50 percent reduction in subsidies on electricity, petroleum products, and natural gas. The results are summarized in table 5.3. One of the most important results was the major risk of an increase in poverty, in part due to a rise in agricultural costs and prices.

For Jordan, using an input-output model calibrated on 2005 data, the IMF estimated that the removal of fuel subsidies would correspond to a price increase ranging from 59 percent for diesel to 65 percent for fuel oil used in the generation of electricity and would lead to an overall price increase of 2.4 percent. The impact on prices by sector would range from 6.9 percent for the nonmetallic industries to 1.6 percent for textiles and apparel (IMF 2006b). The total impact on household real incomes was estimated to be about 4.4 percent (table 5.4). Total subsidy removal was found to be regressive because kerosene, which poor households use most, was receiving a very high subsidy rate.

Table 5.3 Egypt: modeling economic and social impacts, 2005

Economic impacts	% change
Prices	
Domestic price of oil	+67
Domestic price of natural gas	+162
Agriculture	+59
Other sectors [a]	+18
Other impacts	
Domestic petroleum-product consumption	–5.7
Demand for electricity	–3.4
Demand for natural gas	–10.3
Petroleum exports	+13
Exchange rate in percent	+1.8
Household welfare as share of GDP	–0.9
Poverty incidence	+14 [b]

Source: World Bank 2005.
a. More details on the impact on sectors are given in chapter 2.
b. Equivalent to 9.6 million people (20–34 percent of the population)

Similarly, for Iran, World Bank simulations showed how the removal of energy subsidies would affect various social groups differently. Households in rural areas would suffer more than urban households. In both areas, the proportionate loss in welfare due to the higher prices would be greatest for the poorest households, ranging, for rural households, from 47.6 percent (poorest quintile) to 29.6 percent (richest quintile), and, for urban households, from 33 percent to 25.2 percent. The burden would be heavier on rural households, both because of their lower general expenditure level and because of the nature of the goods that they purchase.

These calculations show that the proportional impact of subsidy removal can be greatest for the poor, even though the rich receive most of the total value of the subsidy. This reinforces the message that equitable social protection should replace regressive subsidies.

Table 5.4 Jordan: income effect of subsidy removal

Aggregate real income impact (range from bottom to top income quintile)	Percentage change in impact		
	On all households	On the poorest quintile	On the richest quintile
Direct	2.0	3.0	1.7
Indirect	2.4	2.3	2.4
Total	4.4	5.4	4.1

Source: IMF 2006b.

Identifying compensation measures

Governments in the region often have accompanied price increases with time-bound subsidies of "basic needs" such as fuel and electricity, wage increases for salaried workers (in particular, civil servants), and cash payments.

The CGE analysis of the Egyptian economy discussed above revealed that simply converting 50 percent of energy subsidies into a flat cash transfer to all households without any targeting would decrease the poverty rate by 6 percentage points (table 5.5). Alternatively, if government removed 100% of subsidies and retained 50% as savings, the poverty rate would scarcely change so long as the other 50% were converted into cash transfers.

Table 5.5 Egypt: poverty rates after elimination of energy subsidies under different scenarios

Percentage of population

<table>
<tr><td rowspan="2">Poverty rate without reform (percent population)</td><td colspan="3">Poverty rates with 50 percent energy subsidy cut*</td></tr>
<tr><td colspan="2">Without untargeted cash transfer</td><td>With savings used as untargeted cash transfer</td></tr>
<tr><td rowspan="5">20</td><td colspan="2">34</td><td>14</td></tr>
<tr><td colspan="3">Poverty rates with 100% energy subsidy cut, and 50% of savings used for transfers**</td></tr>
<tr><td rowspan="2">Untargeted cash transfer</td><td colspan="2">Targeted cash transfer</td></tr>
<tr><td>Geographic</td><td>PMT</td></tr>
<tr><td>21</td><td>21</td><td>18</td></tr>
</table>

Source: World Bank 2005.

* General equilibrium simulation of energy subsidies 50 percent cut.

** Partial equilibrium simulation of energy subsidies 100 percent cut. Poverty rates are calculated with subsidy elimination and 50 percent of savings added to transfers according to targeting. A 15 percent administrative cost is deducted from the transfer value for untargeted and geographic transfers; for PMT targeting, the deduction is raised to 23 percent.

In 2008, Jordan evaluated wage increases, cash payments, and other measures to compensate for increases in energy prices. The compensation package ultimately included (i) wage increases for government employees of $64-71 per month, depending on existing salary levels: employees with salaries below $424/month received an increase of $71/month, while other employees received an increase of $64/month; (ii) one-time targeted cash assistance for households, aimed at private sector employees with an annual per capita income below $1,412; (iii) an increase in monthly cash assistance, under the National Aid Fund (NAF), from $37–47 to $51 per month.[51] A more detailed description of social-protection measures accompanying fuel price increases in Jordan is given in Chapter 7.

Morocco is considering a move away from direct price subsidies to targeted direct income transfers, and is considering promoting the use of grid-delivered electricity and gas as a way of offsetting subsidy removal (Blanchard 2008). This may be a practical option, as the electrification rate in Morocco is high.

Identifying the fiscal cost and benefits of subsidy reform

This is a key element to analyze when planning reform. However, little information is available in the case studies, except in Jordan, where it was estimated that JD 301 million would be needed to raise civil servants' salaries and pensioners' payments (Ibid.). Data may be scarce because other countries have not yet reached the implementation stage.

[51] This information was collected by World Bank staff during the preparation of an internal assessment of the impact of energy price increases in Jordan.

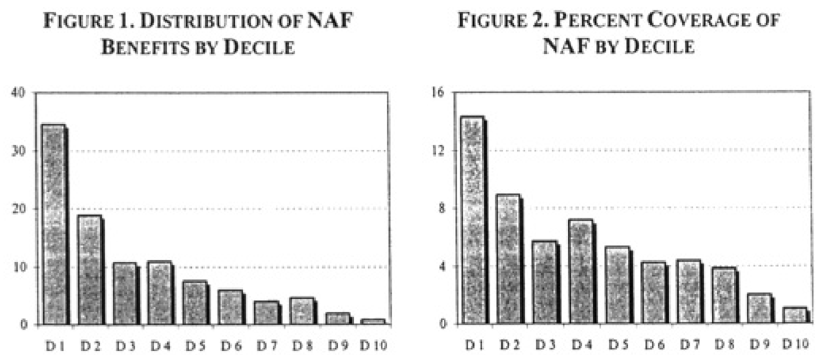
Identifying implementation mechanisms

The early identification of implementation mechanisms is essential to prepare for implementation, to inform the public, and to estimate administration costs. There is no universal appropriate strategy.

In Egypt, although direct cash transfers are still considered by the government, other delivery systems, such as the subsidy card distributed to poor Egyptians, are also under close scrutiny. The government of Egypt is also promoting the use of energy resources other than LPG. It has promised to extend natural gas connections to about 2 million households before 2013 (Ibid.).

Jordan already has experience in cash transfers through the NAF. Created in 1986, this program is a comprehensive, state-funded social safety net. The NAF, however, remains ineffective in reaching the poor. Only about half of all benefits are transferred to the two poorest deciles, and less than 25 percent of the households in these first two bottom deciles are reached (figure 5.4). In other words, the program suffers from leakage to households above the poverty line, and undercoverage of households below the poverty line (85 percent of the households in the poorest decile are not reached).

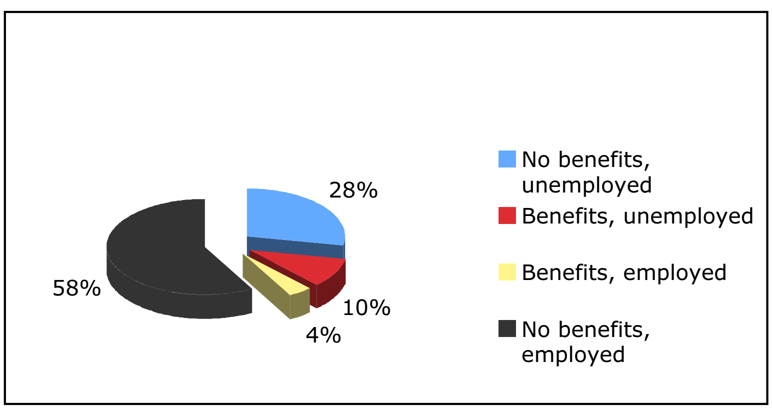
Figure 5.3 Jordanian National Aid Fund (NAF) is ineffective in reaching the poor



Source*:* Gillingham and El-Said 2005.

This evidence suggests that the benefits are mainly transferred to a limited number of households. In fact, benefits are biased toward the unemployed poor at the expense of the working poor (figure 5.5).

Figure 5.4 Employment and NAF status in lowest welfare decile



Source: Gillingham and El-Said 2005.

The government of Jordan assessed the risk of moving forward using the NAF structure to implement its cash-transfer program, but decided that measures first had to be taken to improve its efficiency (Gillingham and El-Said 2005). Those measures include:

- Increasing the inclusion of poor people by using a refined proxy means test
- Requiring households to demonstrate continued eligibility and limiting the duration of benefits
- Implementing comprehensive and frequent appraisals of the system
- Creating disincentives for noneligible households that abuse the system by removing their potential future benefits, a procedure that could be reinforced by random audits across the country and through public reporting of fraud.

Morocco already has a social-assistance program in place that could be used by the government to implement the social-compensation measures of the subsidy-removal program. It includes:

- Public works employment opportunities (such as the Programme de Promotion Nationale) for unemployed or underemployed laborers, as well as other job opportunities provided by the National Employment Agency
- Welfare assistance targeted toward the elderly, female heads of households, and orphans in 500 welfare centers around the country (Blanchard 2008).

Tunisia has had a cash-transfer program (Programme des Familles Nécessiteuses) since 1986; it reached 500,000 families in 1990. The program has been discredited, however, by the lack of targeting and an estimated undercoverage of about 8 percent (Muller and Bibi 2007). The use of more sophisticated proxy means testing might help address the issue.

Iran, by contrast, has focused on targeted fuel subsidies. In 2007, the government decided to ration subsidized petrol to 8 million car owners with smart cards. These cards were based on a daily quota of 3 liters for private cars, and 15–20 liters for taxis. For consumption above the ration the car owner had to pay 33–44 cents instead of 11 cents per liter. This initiative, however, was quickly discredited during the pilot phase because of administrative rigidities and poor organization. Some one million car owners did not receive their smart card on time. The government did not disclose the monthly ration or the price for additional consumption. Technical problems at gas stations could not be resolved. No provision was made for the exchange of defective cards. Lack of controls enabled individuals to use other people’s cards (Blanchard 2008).

Conclusion

Global experience in eliminating energy subsidies shows that effective social protection can make reform politically viable and socially acceptable. The steps to success can be summed up as: analyzing, planning, targeting, timing, and communicating.

In MENA, price and subsidy reform has involved a good deal of analysis but little preparation for implementation. The areas where most progress has been made are the identification of target groups and the analysis of the socioeconomic impact of subsidy removal. This work already shows that the political consequences of reform are complex and require careful planning.

Moving from analysis to implementation requires more systematic and comprehensive planning than has been the case to date (except in Jordan). More systematic work is needed on (a) the content of the compensation package, (b) the public budget needed to finance and administer the measures, and (c) implementation mechanisms. This leads us to the implementation of energy efficiency programs, the theme of Part III.

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Chapter 6: Strengthening Institutional and Financing Frameworks for Energy Efficiency

Institutional arrangements determine the success of campaigns to improve energy efficiency. Effective institutional arrangements make the most of a country's economic, technical, governmental, and political resources and capacities. This chapter sketches out the institutional profile for energy efficiency in the MENA region.

The first two sections provide a brief review of principles, looking at two main institutional categories: (a) *enabling frameworks*, which create the conditions necessary to undertake an energy efficiency campaign; and (b) *implementation arrangements*. These sections also discuss best practices for developing effective institutional arrangements and implementing energy efficiency policies and programs. The last part of the chapter benchmarks the institutional assets of MENA.

Enabling Frameworks for Energy Efficiency

Enabling frameworks include laws and decrees on energy efficiency, national energy strategies and plans, apex agencies for the energy sector, and regulatory regimes. These frameworks provide the overall direction for a national energy efficiency policy, including goals and targets, specific intervention strategies, and funding and other resources. Enabling frameworks of each type are often linked; for example, an energy efficiency law provides the statutory basis for regulations.

Laws and decrees. A government's overall intentions, policy, and strategies for energy efficiency are spelled out in laws and decrees. These may specify time-bound targets and interventions to be undertaken, often at the level of consuming sectors, producers, and industries. Laws and decrees provide the legal authority for any intervention strategy, whether a control mechanism (requirements for producers or consumers), fiscal incentive (such as a tax break), or a dedicated agency. Finally, laws and decrees may specify necessary resources, including government funding and implementation arrangements.

The experience of industrialized and some developing countries (table 6.1) suggests that to provide an effective enabling framework, an energy efficiency law or decree should include all or most of the following elements:

- A clear statement of the government's intent
- Specific goals or targets
- Specific intervention strategies

- Provisions for implementing the legislative intent
- Requirements for monitoring, oversight, and reporting
- Provision of resources (funding and physical) for implementation.

Omission of one or more of these elements can hinder effective implementation.

Table 6.1 Comparison of energy efficiency laws and decrees

Law/decree	Policy intention stated?	Goals specified?	Intervention specified?	Institutional arrangements established?	Resources provided?	Results monitoring specified?
Japan's 1978 Energy Conservation Law	√	√	√	√	√	√
Korea's 1979 Rational Energy Utilization Act	√	√	√	√	√	
Brazil's 1985 Presidential Decree	√	√	√	√		
Thailand's 1992 Energy Conservation and Promotion Act	√	√	√	√	√	√
India's 2001 Energy Conservation Act	√	√	√	√		
Vietnam's 2003 Decree on Energy	√	√				

Source: Heffner 2008.

National energy plans. Countries with centralized planning, such as China and Iran, can effectively use economic development plans to take action. Table 6.2 compares several national energy plans against a set of attributes found in effective enabling frameworks.

Table 6.2 Important attributes of national energy plans: cross-country comparison

National strategy or plan	Addresses all producing and consuming sectors and energy sources?	Describes sector conditions and barriers?	Specifies policies, goals, and interventions?	Assigns responsibility for implementation and monitoring?	Links energy efficiency to broader sector and macroeconomic objectives?
South Africa EE Strategy	√	√			√
China 11th Five-Year Plan	√	√	√	√	√
Denmark National EE Action Plan	√	√	√	√	√

Source: Heffner 2008.

China has made great strides in reducing its economy's energy intensity through a combination of economic plans, targets, and energy-conservation regulations. From 1980 to 2001, China's energy intensity dropped substantially and continuously from 13.34 tce per 10000 yuan to 4.21 tce per 10000 yuan, a 68.4% reduction in total during the 21 years, and 5.4% reduction annually (RCSD, undated). China's 11th Five-Year Plan, covering the period 2005–10, aims to reduce energy intensity by 20 percent between 2005 and 2010. The Plan specifies binding energy-conservation targets for provincial and local governments and state-owned enterprises (SOEs). In 2006–07, the target was 4 percent per year. Officials from regions and companies that do not meet their energy-conservation targets are subject to penalties, such as exclusion from annual rewards programs and ineligibility for promotion (Zhou et al. 2008).

Rules and regulations. These can take many forms, such as minimum energy performance standards for appliances, thermal building codes, compulsory energy audits, energy-intensity caps for larger industrial users, and output-based minimum heat requirements or maximum fuel use for generators. A recent regulatory development has been the outright ban of certain types of energy-intensive end-use devices, such as incandescent bulbs (Ireland by 2009, Australia, Italy and the Philippines by 2010, South Africa and the United Kingdom by 2011, the Netherlands by 2012, and the United States by 2014) and electric water heaters (South Africa by 2011)[52].

As an enabling framework, rules and regulations have many advantages: they are relatively easy and quick to promulgate, they do not require large government investments (except in the development of standards and requirements), they allow for voluntary implementation, and their results can be easily monitored and verified. Energy efficiency rules and regulations can also constitute an intervention strategy. In fact, compulsory standards for production and consumption are one of the few viable strategies where energy prices are highly subsidized.

Energy efficiency regulation is also extremely cost effective from the implementer's standpoint. In the United States, appliance efficiency standards established in 1975 resulted in a 75 percent reduction in average annual consumption for refrigerators, for an annual savings of 200 terawatt hours (TWh) per year (equivalent to 4,000 megawatts, MW, of power generation), at a nominal cost to regulators (Rosenfeld 2007). The cost of implementing these standards, including the cost to manufacturers and consumers, is approximately 3 cents per kilowatt hour (kWh) (Gillingham at al.2004).

Based on the experience of the industrialized countries of the Organisation for Economic Co-operation and Development (OECD) and of developing countries, the International Energy Agency (IEA) recommends that rules and regulations on energy efficiency:

- Have a statutory basis
- Be economical for producers and consumers
- Focus on larger consuming subsectors
- Be established in cooperation with industry and manufacturers
- Be enforceable, with penalties applied in the case of violation
- Include coordinated voluntary measures (standards and labels) and regulations with performance floors and ceilings
- Be phased in over time to accommodate technology improvements

[52] Various articles on www.clasponline.org.

- Be strengthened (to be more stringent) at regular intervals (every 3–5 years), in consultation with industry and manufacturers
- Minimize the regressive effect of regulation on the poor through safety nets (Ellis 2007).

Responsibility for setting and enforcing regulatory regimes varies from country to country. In some countries, new entities have been established to undertake new energy efficiency regulations, such as the Bureau of Energy Efficiency in India. Similarly, the Office of Energy Efficiency (OEE) within Natural Resources Canada—a ministerial-level entity devoted to the coordination and facilitation of that nation's energy efficiency—is responsible for implementing a broad regime of regulations for equipment and appliances, from traffic lights to ceiling fans.

In other cases, such as thermal building codes, the regulatory responsibility may be split between the creator of the regulation (such as a ministry of construction) and the enforcer (usually a municipality). This is not necessarily an optimal arrangement. As a rule of thumb, the government agency most familiar with the producing or consuming sector should be responsible for both creating and enforcing regulation. Table 6.3 provides some suggestions on matching the regulator to the target group to be regulated.

Table 6.3 Matching the regulator to the target group

Regulator	Equipment manufacturers	Builders and developers	Energy producers	Energy distributors	Energy end users
Gas and electricity regulator			Fuel throughput restrictions (tons of oil equivalent per kWh)	Loss limits	Prohibitions on waste
Energy efficiency regulator, ministry of industry	Outright bans on certain types of equipment				Industrial process intensity, compulsory energy audits, end-use efficiency
Municipalities or ministry of housing and construction, bureau of standards	Street lighting and traffic signals	Building thermal codes, exit signs			

Source: Heffner 2008.

Apex agency. An apex agency such as a ministry of energy (MoE) can provide a sufficient framework for implementing intervention strategies when the apex agency is quite powerful, or the intervention strategy is narrowly focused. An example is Kuwait's MoE, which has centralized control over the energy sector, including procurement of electric power. Faced with rapidly growing demand for subsidized electricity, in 1983 the ministry introduced an Energy Conservation Code of Practice for new buildings. The code required thermal insulation for walls and roofs; limited use of glass; and specific performance ratings for heating, ventilation, and air-conditioning systems. The code dramatically reduced the energy demand of new buildings, as well as the peak demand growth of new developments (Heffner, 2008).

Implementation Arrangements

Effective arrangements are needed for the steady and sustainable implementation of energy efficiency strategies. Typical implementation arrangements include:

- *Specialized agencies* for delivering goods and services related to energy efficiency, for example energy efficient equipment and advisory services.
- *Programmatic arrangements* for specific interventions in producing and consuming subsectors
- *Other supporting arrangements*—among them technology development and scientific services from academic and research entities, capacity-building arrangements for industrial and private sector groups, and the mobilization of civil society (including nongovernmental organizations, NGOs).

Certain implementation activities (such as fiscal incentives and the enforcement of rules and regulations) can be performed only by a government or quasi-governmental body, while others (such as the delivery of energy efficiency goods and services) can be done by any private or public sector entity, assuming that sufficient capacity exists. In many countries, vertically integrated utilities and electricity-distribution companies have enjoyed early success in implementing efficiency strategies, both in production and consumption. These utilities have developed expertise in implementing efficiency strategies thanks to their access to capital, existing relationships with end users, access to information (billing systems and market data), and technical capacity.

The four categories of implementation arrangements described below are usually found in well-developed national programs. The need for implementation arrangements will vary according to the intervention strategy. If a purely private sector–led approach is taken, there may not be a need for a specialized public agency. If there is sufficient access to commercial lending, then dedicated financing arrangements may not be necessary.

Energy Efficiency Agencies

Most countries with large energy efficiency programs rely on specialized agencies to implement efficiency campaigns. These entities undertake specialized activities according to the type of intervention and the sector affected by it. According to a recent survey of 29 energy efficiency agencies in the OECD and developing countries, these agencies have distinct organizational models, ranging from a specialized office within an apex government agency, to independent SOEs focused on overseeing energy efficiency interventions (Taylor et al. 2008). Earlier agencies established in the 1980s and early 1990s were housed within apex energy agencies. The OEE within Natural Resources Canada is an example. More recently, energy efficiency agencies have been established within a public agency focused on "clean energy" (for example, energy efficiency and renewable energy) or on energy efficiency alone. A few entities have been established outside the government, as independent statutory authorities or state-owned corporations (table 6.4).

Table 6.4 Energy efficiency agencies and their enabling mechanisms

Country	Agency name	Enabling mechanism	Institutional model
Brazil	PROCEL	Presidential Decree (1985)	EE public agency
Canada	Office of Energy Efficiency	EE Act (1995)	EE office within an apex agency
Finland	MOTIVA	National Legislation (1993)	Clean energy public agency
France	ADEME	National Legislation (1989)	Clean energy public agency
Germany	DENA	Government Order (2000)	Clean energy public agency
India	Bureau of EE	Energy Conservation Law (2001)	EE public agency
Ireland	Sustainable Energy Ireland	Sustainable Energy Act (2002)	Clean energy public agency
Japan	Energy Conservation Center	Energy Conservation Law (1979)	EE public agency
Korea	Korea Energy Management Corporation	Rational Energy Utilization Act (1980)	State-owned enterprise focused on EE
Mexico	CONAE	National Legislation (1989)	Clean energy public agency
New Zealand	EE and Conservation Authority	EE and Conservation Act (2002)	EE public agency
Norway	ENOVA SF	National Legislation (2001)	Clean energy public agency
Serbia	EE Agency	Energy Law of 2004	EE public agency
Sri Lanka	Energy Conservation Fund	Energy Conservation Act (1985)	EE statutory authority
Thailand	Dept. of Alternative Energy Development and Efficiency	Energy Conservation and Promotion Act (1992)	EE public agency
U.K.	Energy Saving Trust	National Legislation (1993)	EE NGO

Source: ESMAP 2008a.

Each organizational model has both advantages and limitations. Energy efficiency offices embedded within apex agencies are better able to influence overall energy policy and perhaps attract funding. But they may be limited in their ability to pay salaries sufficient to attract qualified staff. On the other hand, both statutory authorities and independent corporations are able to attract qualified staff, but their position outside the government may reduce access to public funding, unless funding arrangements are specified by statute or in the corporate charter. Similarly, public agencies with a broad mandate to pursue clean energy—including energy efficiency and renewable energy—may face internal conflicts over prioritizing the funding and policy attention for these different responsibilities.

Another consideration is the congruence of responsibilities with the organizational model. Public agencies have more stakeholder credibility than private entities when determining how to implement intervention strategies. Likewise, interventions featuring a control mechanism, such as appliance standards and building codes, are most effectively implemented by government agencies. Organizational models that allow more flexibility and faster decision making, such as independent corporations and statutory authorities, may be better suited to building private sector capacity and administering the delivery of energy efficiency goods and services.

Consultations and discussions with energy efficiency agencies (ESMAP 2008a) identified key steps in developing the most appropriate organizational model:

- Consider what organizational model and location will be best suited to specific intervention strategies.
- Consider what organizational model and location will be best suited to the targeted sector (for example, industrial, commercial, building, housing, transport, agricultural).
- Consider the skills and technical capacity needed to implement the intervention strategy (for example, regulation, market transformation, technology and industrial development, financial intermediation).
- Consider the trade-offs between placing the agency close to the centre of government, which allows it access to political decision makers, and giving it more autonomy.

Programmatic Arrangements: Oversight, Administration, and Delivery

Programmatic arrangements can be defined as purpose-driven, time-bound programs with a dedicated source of funding and management. Examples of programmatic arrangements include the rehabilitation of thermal power plants to provide both heat and power; bulk procurement and mass-market distribution of compact fluorescent lights (CFLs) or other energy-efficient appliances; and the large-scale implementation of energy audits for buildings and industrial facilities.

Programmatic arrangements involve oversight, administration, and delivery tasks (table 6.5). Program *oversight* must be performed by a government body, an independent board, or an organization contracted by either, while other functions can be undertaken by public or private entities. Program *administration* may be performed by an energy service provider and partners, such as local or provincial governments. Program *delivery* can be done by any number of private or public sector entities, including utilities and other energy service providers, nongovernmental organizations (NGOs), commercial entities such as energy service companies (ESCOs), and even equipment manufacturers or retailers. Utilities' demand-side management (DSM) programs enable the energy service provider to cover all aspects of investment in energy efficiency, including marketing, technical design, financing, and service delivery. The costs are usually recovered through tariffs.

Table 6.5 Functional breakdown of programmatic implementation arrangements

	Potential arrangement
Oversight	Energy efficiency agency Regulator Independent oversight board
Program administration	Energy service provider Local government Energy efficiency agency
Program delivery	Energy service provider Energy service companies Manufacturers or retailers

Program administration may be the most demanding implementation task because it requires a significant repository of technical and managerial capacity, as well as financial and tracking systems. Choosing a program administrator should take into account practical and political considerations, including the beneficiaries of the program and relationships with the target population and program deliverers.

No single programmatic arrangement is superior to the rest. Rather, it is the details of the intervention strategy that will drive selection of the appropriate arrangement.

Other supporting arrangements. Other supporting arrangements may include the promotion of awareness of energy efficiency in civil society; the development of educational curricula; the development of private energy efficiency businesses; encouragement of professional and industrial associations focused on energy efficiency; and partnerships with scientific and academic institutions.

The development of private energy efficiency businesses is particularly important because it creates the economic capacity to undertake implementation activities. Energy Service Companies (ESCOs), in particular, are a good model for sustainable implementation of energy efficiency investments that do not require extensive government intervention—assuming that the barriers to energy efficiency, especially any energy price subsidies, have been removed.

ESCOs can take many forms and perform a wide range of services (box 6.1). But the private sector needs to be encouraged to enter the marketplace. Initially, this can be done by providing opportunities for ESCOs to develop and implement energy efficiency projects, for example, by requiring public sector facilities to undergo energy audits and improve energy efficiency in public buildings. These guaranteed "early markets" provide ESCOs with an opportunity to build capacity and develop skills. For example, in the United States, the 1992 Energy Policy Act required federal agencies to enter into energy savings performance contracts with ESCOs. This was a primary cause of the industry's rapid growth over the past 15 years (Hopper and Goldman 2004).

Besides providing private sector participation and financing, ESCOs transfer technical risks away from end users and financiers. They can also package smaller projects, bundle the procurement of goods and services, and take on project performance and credit risks. But creating strong and credible ESCOs and ESCO markets has proved very challenging in many countries. Emerging and developing economies often lack the legal and financial infrastructure to adapt and support such business models. Equity markets are limited, and few investors have the funds required to create new companies to test such business types. In addition, new ESCOs often lack the range of skills (corporate management, financial management and credit assessment, risk mitigation, management, and sales) required to bring credibility to customers and financiers (World Bank/GEF 2005).

Another good example of a supportive arrangement is building the capacity of architects and engineers to design energy-efficient buildings. India is a pioneer in the area of green buildings, having established the Indian Green Building Council (IGBC), developed a customized rating system (Leadership in Environmental and Energy Design, or LEED), and sponsored an annual flagship event known as the Green Building Energy Congress, which offers awards for the best green building design. Several green-building activities are being supported or encouraged by the private sector, and a number of very large projects are underway (IRG 2004).

Box 6.1 Examples of ESCO business models

Full-service ESCO: The ESCO designs, finances, and implements the project; verifies energy savings; and shares an agreed percentage of the actual energy savings over a fixed period with the customer.

ESCO variable-term contract: This is similar to the full-service ESCO, except that the contract term may vary based on actual savings. If actual savings are less than expected, the contract can be extended to allow the ESCO to recover its agreed payment.

End-use outsourcing: The ESCO takes over operation and maintenance of the equipment and sells the output (such as steam, heating/cooling, or lighting) to the customer at an agreed price. The ESCO bears the costs of all equipment upgrades, repairs, and so on, but ownership typically remains with the customer. This is also referred to as contract energy management.

ESCO with third-party financing: The ESCO designs and implements the project but does not finance it, although it may arrange for or facilitate financing. The ESCO guarantees that the energy savings will be sufficient to cover debt-service payments.

Equipment supplier, with supplier credit: The equipment supplier designs and commissions the project, verifying that performance and energy savings match expectations, and provides supplier credit. Payment can be made either on a lump-sum basis after commissioning, or over time (typically from the estimated savings). Ownership of the equipment is immediately transferred to the customer.

Equipment leasing company, with supplier credit: Similar to the equipment supplier, the leasing company provides credit and receives fixed payments from the estimated energy savings. The supplier owns the equipment until all the lease payments, and any transfer payments, are completed.

Technical consultant (with performance-based payments): The ESCO conducts an audit and assists with project implementation. The ESCO and customer agree on a performance-based fee, which can include penalties for lower energy savings and bonuses for higher savings.

Technical consultant (with fixed payments): The ESCO conducts an audit, designs the project, and either assists the customer in implementing the project or simply advises the customer for a fixed, lump-sum fee.

Source: Adapted by D. Lallement from World Bank/GEF 2005.

Financing Arrangements

Financing arrangements are such an essential part of the implementation of an energy efficiency campaign that they deserve separate treatment. Access to financing is one of the most common barriers to investment in energy efficiency. Households, managers of industrial and service companies, government bodies, and other types of consumers all have limited budgets and competing spending priorities. All energy consumers are also highly sensitive to the up-front costs of investments.

Taylor et al. (2008) analyze the results of an exhaustive 10-year study of financing arrangements, with a focus on ESCOs and utility DSM programs in India, China, and Brazil. The authors observe that the "*lack of domestic sources of capital is rarely the true problem; rather, it is inadequate systems for accessing financing that are at fault*." Getting financing to those who most need it and can best use it is, therefore, critical to any campaign that depends on investments in energy efficiency.

Financial remediation for use in energy efficiency projects is complex. A hierarchy of issues needs to be addressed: financing needs; risks, returns, and available financing instruments; sources of funding; and institutional mechanisms for accessing those instruments and sources.

Identification of financing needs. Two main categories of activities require financing: (a) pre-investment activities (that is, the marketing, project development, and technical design needed to efficiently package good projects), and (b) investment implementation. A common source of program failure is the inadequate balance of these two categories of needs, which leads either to insufficient project pipeline development to meet the needs of financiers, or to the inability to arrange and deliver financing for a series of well-developed projects. In Tunisia, for example, financing is now available for only a fraction of prepared projects (ESMAP 2008b).

Risks, returns, and financing instruments. A project's risks and returns must be identified before the right mix of financing instruments can be assembled. Energy efficiency can be costly, risky, and complex to administer. Over the past 25–30 years, many different financing instruments have been developed and used—among them outright subsidies to producers or consumers that bring down the up-front investment cost, concessional loans (with low interest or long maturity), partial loan guarantees to mitigate the risks perceived by commercial lenders, loan-loss reserve funds, rebates on energy audits, and investment grants.

Sources of funding. Funding for energy efficiency projects may come from the private sector (financial markets, equity, commercial banks) or the public sector (public budgets, dedicated funds, bilateral and international development assistance). In some countries, the financial markets and companies engaged in energy efficiency are sufficiently developed to raise the needed financing without public support. But in most cases, including in advanced economies, public resources are needed either to support a specialized agency or to provide some sort of fiscal incentive to the private sector. In Ireland, for example, the government allocates about €14 million per year to Sustainable Energy Ireland. The agency supports four programs—in industry, construction, household energy, and renewables, with subsidies for the latter three programs. Industries finance their own energy efficiency investments. The agency, however, has 80 industry contracts through which it develops best-practice investments; part of the agency's own budget is used to disseminate the results. The budget allocated to Sustainable Energy Ireland is small compared to that of the French Energy Efficiency Agency (ADEME), which also covers renewables, and has an annual budget of about €500 million.

Institutional mechanisms. End-users gain access to funds through institutions that differ from country to country. A wide range of mechanisms exists—from dedicated energy efficiency funds, to loans and guarantees provided by commercial banks or dedicated (revolving) funds, to various forms of third-party financing through ESCOs, utilities, and suppliers.

The choice of the mechanism used to deliver financing will depend on the fund source, the nature of the barriers to financing, the type of investment, and the financing instrument used. In all cases, investment and funding systems must fit local institutional environments in order to be effective. The World Bank/ESMAP study reported by Taylor et al. (2008) finds that funding systems developed in the institutional environment of one country may not be effective in that of another. If externally funded initiatives are to be successful, the sponsors must customize their interventions to unique national and regional environments.

Other financial arrangements, in addition to those mentioned above, include the following (see also table 6.6):

- *Bulk-equipment purchase and distribution arrangements.* Energy service providers purchase large quantities of energy-efficient goods from manufacturers, who pass these savings to end-users.
- *Credit and repayment schemes.* Energy service providers cofinance the initial cost of an energy-efficient appliance through a credit to the retailer (covered by the monthly energy bill paid by household consumers).
- *Lease-back arrangements.* An ESCO purchases equipment and leases it to a business or industry. The ESCO recovers its investment through shared savings from the energy efficient investment.
- *Concessional lending + revolving fund.* Development Finance Institutions finance investments, and a share of the subsequent savings flow back to create a revolving fund.

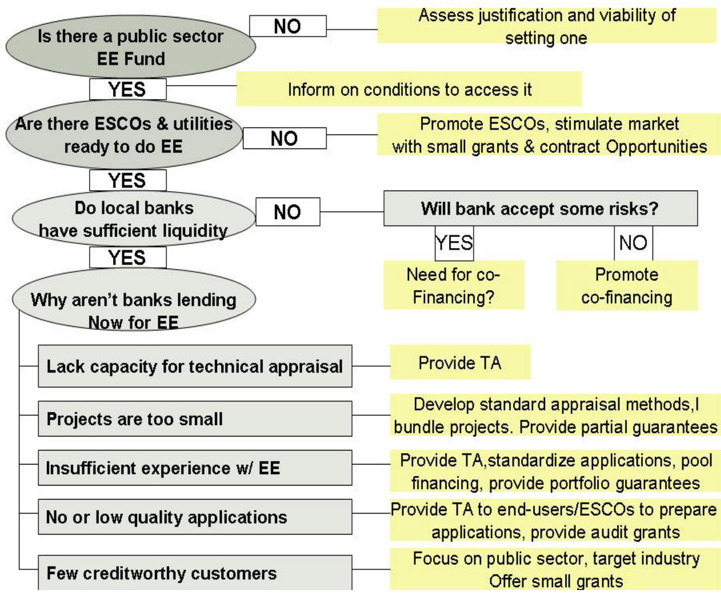
Table 6.6 Indicative financial arrangements and transacting parties

Financing arrangement	Equipment manufacturers or retailers	Builders and developers	Energy producers	Households	Business and industry
Bulk purchase and distribution	Energy services provider			Equipment retailers	
Credit and repayment	Energy services providers			Energy service providers and equipment manufacturers	
Lease-back arrangements	ESCOs		ESCOs		ESCOs
Third party financing		ESCOs	ESCOs		ESCOs
Revolving funds			ESCOs or asset owners		ESCOS or asset owners

Special revolving funds for energy efficiency investments have shown impact. In China and elsewhere, these funds have become "one-stop shops," combining financial intermediation with project preparation. In some cases where the commercial banking sector is not well developed or where the private sector is averse to energy efficiency investments, these dedicated funds may be the only way to build the energy efficiency market and create a project pipeline. These funds can be developed to lend directly to industry, to ESCOs, or both.

Choosing the right financial arrangement depends on many factors, including the nature of the intervention, the capacity of financial institutions, the financial resources of the government, and the capacity of both asset owners and ESCOs. A decision tree for energy efficiency financing programs can help practitioners select the financing framework best adapted to local needs (figure 6.1).

Figure 6.1 Sample decision tree for energy efficiency financing programs



Source: Adapted by D. Lallement from World Bank/GEF 2005.

Benchmarking Institutional Arrangements in the Region

MENA has a rich experience with energy efficiency programs and institutions. This section draws on a survey of that experience,[53] focusing on countries with recognized energy efficiency activities (Algeria, Egypt, Iran, Israel, Jordan, Lebanon, Morocco, and Tunisia) as well as other countries in the region that have undertaken energy efficiency programs more recently (Djibouti; the Gulf states, including Kuwait and Saudi Arabia; Iraq; Libya; the West Bank and Gaza; and Yemen). The survey looked for the following information for each country:

- Energy efficiency intervention strategies under implementation
- Enabling frameworks for energy efficiency (laws and decrees, national plans, rules and regulations, and apex agencies)
- Arrangements for implementing energy efficiency interventions (dedicated or specialized agencies; and programmatic, financial, and other supportive arrangements)
- Monitoring of results.

[53] The main sources of information for the survey were World Bank documents (both published and internal); secondary literature available on Web sites; and academic papers, journal articles, and conference proceedings prepared by energy specialists and development practitioners in the region.

The survey found that 2007–08 was a critical juncture in the development of energy efficiency policy in the region. Groundbreaking new legislation and policies were underway or imminent in several of the countries reviewed.

In *Egypt*, a framework law under development for more than four years is being considered by the government. The law would codify a number of programs and policies and add two new authorities—one to create financing mechanisms and one to lead program implementation.

In *Syria* an energy conservation law is being drafted. The legislation would create a statutory basis for relevant activities, including financial assistance and a thermal insulation code for buildings.

In *Jordan*—one of the few countries to have recently eliminated most fuel subsidies—a new energy efficiency center is being established, and the government is preparing a major information campaign on energy efficiency.

In *Morocco* a new program to accelerate the advance of renewable energy and energy efficiency was announced by the Council of Ministers in early 2007. Components of the plan include an energy efficiency code for residential and commercial buildings, plus energy-demand initiatives focused on commercial and industrial customers.

In *Saudi Arabia* a major effort is underway to develop a master plan for energy conservation. This effort was expected to provide firm recommendations for energy efficiency interventions beginning in late 2008 (JICA 2007).

A new Mediterranean Centre for Renewable Energy and Energy Efficiency (MCREE) will soon complement these national efforts. Conceived as part of the Euro-Mediterranean Partnership, located in Cairo, and funded by the European Union, Denmark, and Germany, the center involves signatories of the Barcelona Declaration: Algeria, Egypt, Israel, Jordan, Lebanon, Morocco, Syria, Tunisia, Turkey, and the West Bank and Gaza, plus Yemen. In January 2008, all southern Mediterranean countries in the Euro-Mediterranean Partnership, joined by Yemen, formally declared their support for the center. Its specific objectives are to:

- Stimulate exchanges of experience and cooperation in research and development toward energy solutions for the region
- Promote regional consistency in energy policies, as well as shifts in the energy mix toward sustainable, clean energy
- Stimulate technology transfer and market development for energy efficiency and renewable energy
- Speed the creation of an integrated energy market.

The survey of intervention strategies and institutional arrangements for energy efficiency found that 11 countries have some manner of government-sponsored institutional arrangements for at least one sector. In the other 9 countries, it found no discernible government-led institutional arrangements for energy efficiency. Results for the 11 countries are reported in table

6.7. The table is organized into three parts: (a) intervention strategies identified, (b) enabling frameworks in place, and (c) implementation arrangements.

Table 6.7 Intervention strategies and institutional arrangements for energy efficiency in selected MENA countries

	Algeria	Egypt	Iran	Israel	Jordan	Kuwait	Lebanon	Morocco	Saudi Arabia	Syria	Tunisia
Intervention strategies identified											
Regulation	√	√	√	√		√				√	√
Pricing											
Incentives		√	√		√						√
Direct investment		√	√		√		√				
Market transformation	√		√	√	√			√	√	√	√
Technology development											
Industry development			√	√	√			√	√	√	√
Financial remediation	√		√					√			√
Enabling frameworks in place											
Energy efficiency laws and decrees	√			√					√		√
National energy plans		√	√	√	√			√		√	√
Energy efficiency regulations and rules	√	√	√	√	√	√				√	√
Apex agency for the energy sector	√	√	√	√	√	√	√	√	√	√	√
Implementation arrangements											
Energy efficiency agency	√		√	√	√	√	√			√	√
Programmatic arrangements	√		√	√			√	√	√	√	√
Financing arrangements			√					√			√
Other supportive arrangements	√	√	√	√	√	√	√	√	√	√	√
Results monitoring			√			√					√

Source: Heffner 2008, based on literature survey

At this time, only two countries in MENA have what might be deemed comprehensive institutional arrangements for energy efficiency: Iran and Tunisia. These two countries most closely approach the ideal both in their *enabling frameworks* (laws and decrees, national energy plans, regulation and rules, and an apex agency) and *implementation arrangements* (specialized agencies plus programmatic, financing, and other supportive arrangements). An important caveat, though, is whether good use is being done in practice of these enabling frameworks and implementation arrangements.

Several countries in MENA stand out as having a longstanding and sustained commitment to energy efficiency. These include Algeria, Israel, Kuwait, and Tunisia—all of which developed legislation and created agencies focused on energy efficiency in the mid-1980s. In a second set of countries, institutional arrangements are not comprehensive but may well be optimal given the countries' sector conditions. For example, Israel has a legal framework in place (the Energy Resources Law of 1987), rules and regulations governing some forms of consumption (household appliances), and an agency specializing in energy efficiency (Infrastructure Resources

Management Division of the Ministry of National Infrastructure). But Israel lacks a financing facility.

Eight countries have created agencies to implement energy efficiency initiatives. Six of these agencies are dedicated solely to energy efficiency, and several have been in place for a long time, including Algeria's National Agency for the Promotion and Rational Use of Energy (established in 1985), the Iran Efficient Energy Organization (1994), the Infrastructure Resources Management Division of Israel's Ministry of National Infrastructure (1987), and the Rational Use of Energy Division of Jordan's National Energy Research Center (1998).

Another seven countries have promulgated rules and regulations for energy efficiency in production and consumption. Several more are developing some form of regulation of energy efficiency (usually appliance standards or building codes).[54] Among the active regulatory regimes in the region are the following:

- In *Algeria*, thermal building codes apply to houses and commercial buildings. Energy audits for large consumers are mandatory.
- In *Egypt*, standards and labeling programs cover refrigerators, air-conditioners, and washing machines.
- In *Iran*, some appliances (refrigerators and air-conditioners), as well as new buildings, must meet energy efficiency requirements.
- In *Israel*, energy efficiency standards apply to refrigerators and air-conditioners. ESCOs must be licensed.
- In *Kuwait*, although effective, Kuwait's energy efficiency interventions and arrangements are narrowly focused on construction. An energy conservation code for all new buildings, promulgated by the MoE, ensures energy-efficient construction even though Kuwait's electricity prices are among the lowest in the world. The code of practice is overseen and enforced by the specialized Buildings and Energy Technologies Department of the Kuwait Institute for Scientific Research.
- In *Tunisia*, efficiency requirements are applied to buildings and appliances.
- In *Syria*, energy efficiency labels are required on refrigerators, air-conditioners, and washing machines. New houses and buildings must conform to a thermal insulation code
- In *Morocco*, the Framework Law on Renewable Energy and Energy Efficiency is being revised. The Renewable Energy Development Center, created in 1982, focuses on energy efficiency. Financing is available, mainly for solar water heaters, and an energy efficiency code for new construction is under development.

Financing arrangements are relatively sparse across the region. Only four countries have established financing mechanisms dedicated to energy efficiency; of these, most center on household solar water heaters. Algeria has a National Fund for Energy Control, created by decree

[54] Further country-specific research is needed on arrangements for enforcing these regulations.

in 2000 (box 6.2). Iran has developed a financial facility for promoting energy efficiency projects, with priority given to large industrial and commercial consumers. Demonstration projects are eligible for financing of up to 100 percent of their costs, while 50 percent financing is available for the costs of energy audits and proven energy savings measures.

The Iranian electricity company, Tavanir, has provided financial incentives for CFLs since 1995, with the objective of stimulating domestic sales and manufacture of high-efficiency lamps. Different programs over the years have sold lamps at subsidized prices (with manufacturers being reimbursed from the state) or mobilized regional electricity companies to distribute CFLs directly to customers, with term repayment through their electricity bills.

Box 6.2. Algeria- National Energy Efficiency Fund

The National Energy Efficiency Fund of Algeria (FNME) was created in 2000 (Decree no. 2000-116), with the objective of financing energy efficiency investments as well as the budget of the National Energy Efficiency Agency (APRUE) and the projects it manages under the National Energy Efficiency Program (PNME), FNME's annual budget is estimated at AD 500 million (Euro 57 million). The resources of the funds include taxes on natural gas (AD 0.00015/btu) and electricity (AD 0.02/kWh), and an initial government contribution of AD 100 million (Euro 1.15 million). Additional resources may include taxes on energy intensive equipments, penalties, loan reimbursements, and government or other contributions. The FNME finances investments through grants, subsidized loans, or loan guarantees, under five major programs: the 'Eco-Light' program which aims to disseminate 1 million CFLs to households, with a 50% subsidy of the price; the 'Eco-Building' program which aims to construct 600 high energy efficiency housing units, and to contribute from the fund 80% of the incremental costs as well as the feasibility studies; the 'Al-Sol' program which aims to disseminate solar water heaters in households, with a 40 percent subsidy on the investment cost, and subsidized loans for 50 percent of the cost; the "Clean Air" program to facilitate the conversion of private cars to natural gas, with subsidzed loans on the total conversion cost (equipment plus labor); and the 'Industrial' program, covering the cost of energy audits and feasibility studies up to AD 700,000, and subsidies on investments of up to 20% for electricity projects, 30% for thermal projects, and 10% for cogeneration projects.

Source: Kamel Dali, APRUE. PPT presentation, Tunis Workshop. November 2008.

Morocco actively promoted solar water heaters through both the Center for Renewable Energies Development (CDER) and the electric utility Office Nationale de l'électricité (ONE). Under a program known as ECOSOL, a fund of $1.2 million was established to finance solar water heater installations in hotels, with financing provided through ONE. Recipients repay the loan through their utility bills.

Tunisia has also been very successful in creating financial arrangements that support the rational use of energy. The National Energy Savings Fund, created in 2005, provides standing subsidies for qualified energy efficiency actions, including a 20 percent subsidy of all business investments in rational use of energy and a 50 percent subsidy of energy audit costs. The fund is replenished by duties levied on registrations of private cars and on imports of air-conditioning equipment.

All the countries surveyed rely on other supportive arrangements as well. It is typical for national standards-making bodies to perform the technical analysis required for energy efficiency rules and regulations, while an energy efficiency agency promulgates and enforces the result.

Other mobilized stakeholders include academic institutions, NGOs, industry associations, and research institutions.

Conclusion

Effective institutional arrangements for planning, financing, and executing strategies to increase energy efficiency are useful ways to build on the economic pillars discussed in chapters 4 and 5. Three major conclusions from the review of MENA's experience with such institutional arrangements have emerged:

- Many countries in the region already have a solid institutional base on which to build investment in energy efficiency. In some countries, the necessary institutions are operational. In others, they need to be reinforced. In still others, institutions are lacking.
- The countries of the region have comparatively little experience in using a wide range of financing instruments, as most programs to date have been donor supported, except in Algeria, Iran, and Tunisia.
- Developing an effective and sustainable energy efficiency market with competent service providers and reliable financing sources takes time. The countries that started earlier are performing better than those that have only recently begun to promote energy efficiency.

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Chapter 7: Managing the Transition – International Good Practices

What can be learned from countries that have achieved a measure of energy efficiency? This chapter focuses on good energy-reform practices, with examples from five countries around the world. The term "good" has been used instead of "best" practices to encompass the diverse solutions possible as each country finds the path suited to its unique political, economic, and institutional environment.

In one way or another, many countries around the world have demonstrated their political commitment to increasing energy efficiency. Good practices include five key operational elements: long-term commitment and institutional development; the right entry points and the right pace of policy change; mobilization of sustained financial resources; effective, sustained measurement of results; and, most importantly, communication with the public.

This chapter reviews four case studies from outside MENA, chosen either for their comprehensive results (Brazil, China, and Japan) or for their particularly adept handling of a difficult entry point (Indonesia). Then, the case of Jordan is reviewed to illustrate that this MENA country compares well with the other examples given.

Brazil: Commitment, Communication, and Demand-Side Management

Brazil's experience is particularly interesting for MENA countries. A middle-income country that grew at an average rate of 3.7% p.a. over the 35 years to 2006, Brazil has experienced an increase in energy demand of more than 4 percent a year. As a result, its energy intensity increased by 16 percent over the period 1970–2005. The International Energy Association (IEA) estimates that annual growth in the gross domestic product (GDP) will continue to average 3 percent until 2030, with energy demand also staying on trend (IEA, 2006).

Brazil has used energy efficiency as a supply option to improve energy security in response to both the oil shock of the early 1970s and the widespread 2001–2 power shortages, which were due primarily to insufficient rainfall and resulting cutbacks in hydropower. The nation has also used energy efficiency and social protection to support reforms of the power sector and of petroleum-product pricing. An innovative financing mechanism now supports the implementation of Brazil's energy-efficiency policy. Throughout, the country has relied on comprehensive communication campaigns to induce the population to adopt energy-efficiency measures.

Energy efficiency as a supply option to improve energy security

The oil shock of the early 1970s prompted Brazil to introduce alternatives to imported oil. At the time, Brazil's own petroleum reserves remained for the most part undiscovered. The government took a two-pronged approach to decreasing dependence on imported fuel. First, in 1975, it launched a program to promote the use of sugarcane ethanol as a partial substitute for gasoline. Second—and this is our focus here—in 1981 it launched the National Program for Energy Conservation, reinforced in 1985 by the National Program for Electricity Conservation and again in 1991 by the National Program for Petroleum Products Conservation.

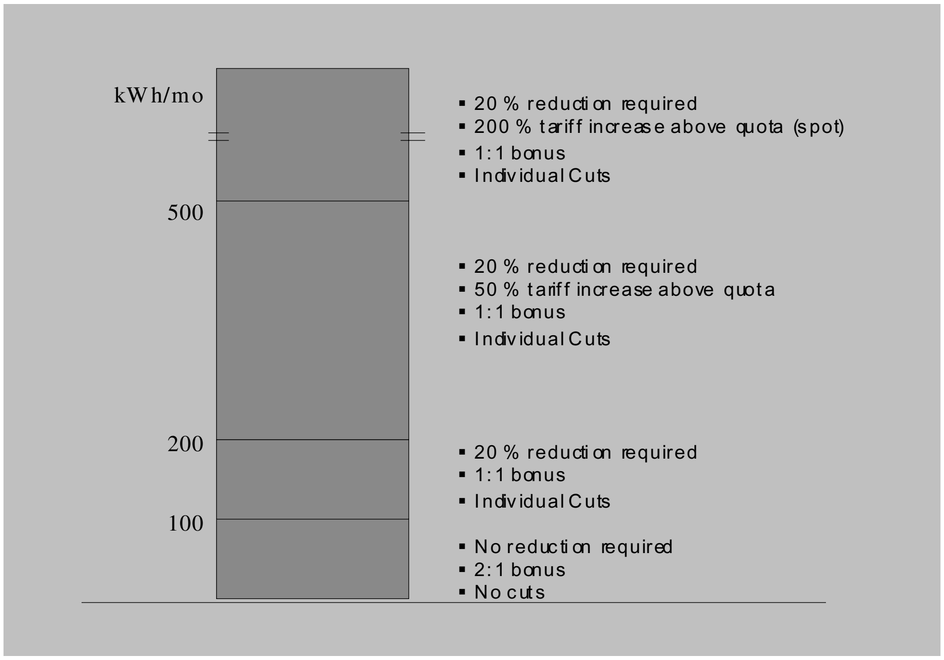
> **Box 7.1 Brazil: Timeline of energy conservation and efficiency policies**
>
> 1975—Alcohol Program for cars (PROALCOOL)
>
> 1981—National Energy Conservation Program
>
> 1984—Brazilian Labeling Program
>
> 1985—National Program of Electricity Conservation (PROCEL)
>
> 1991—National Conservation Program for Petroleum Products (CONPET)
>
> 1998—Energy efficiency in utility contract concession—Privatization
>
> 2000—Energy Efficiency Program for Electric Utilities (PEE)
>
> 2001—Minimum efficiency equipment and building law
>
> 2002—Minimum efficiency level for induction motors
>
> 2004—Target plan for induction motor efficiency
>
> 2006—Minimum efficiency level for compact fluorescent lamp
>
> 2006—Minimum efficiency level for refrigerator and air conditioner
>
> *Source:* ESMAP 2006.

As with many such programs dating back to the 1970s, the initial focus was on energy *conservation*. It took another 15 years to shift the focus to energy efficiency (box 7.1). Most measures in these programs were technical and aimed at reducing demand; they ranged from labeling equipment and appliances to determining energy-efficient performance standards.

Substantial improvement in the efficiency of the power sector, however, came in response to the power shortage of 2001–2 (ESMAP 2005). The crisis was preceded by several years of drought, as well as insufficient investment in thermal generation capacity. After much debate over how to handle the power shortage and avoid rolling blackouts, the authorities decided to implement a power-rationing system that combined a quota system with price signals and social protection. That solution led to significant changes in energy-consumption behaviors—changes that outlasted the crisis.

The two-way quota system, combined with price signals and social protection, limited consumers to approximately 80 percent of the previous year's consumption, with bonuses paid to those who consumed less and penalties levied against those who consumed more. Low-income, low-level consumers were not asked to reduce their consumption, but they could still benefit from the bonus (figure 7.1).

Figure 7.1 Brazil: energy-efficiency targets by level of household consumption

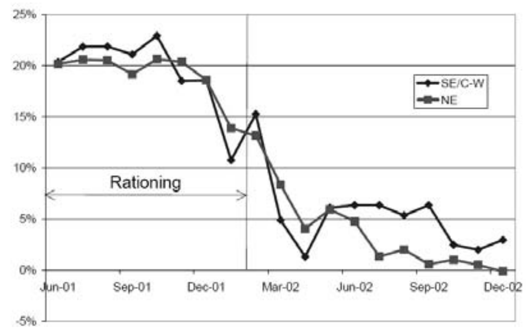


Source: ESMAP 2005

The scheme proved to be extremely successful in (a) reducing demand (figure 7.2), (b) avoiding blackouts and brownouts, and (c) securing energy for industry and households, with positive effects on income and employment. Industrial production and GDP continued to grow during the crisis, and employment rates remained relatively flat. The pricing system, in tandem with a widespread information campaign on how to save energy, was critical in engaging people in the effort to conserve energy (figure 7.3).

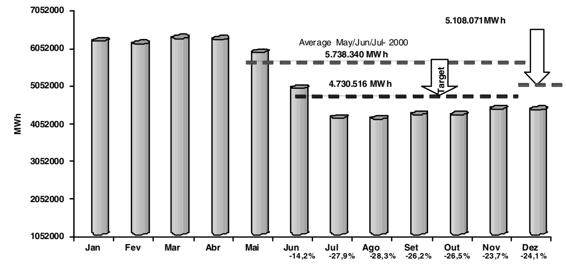
Total energy saved amounted to 26 terawatt hours (TWh) over 2 years, or 13,400 peak TWh—almost 10 percent of total consumption (284 TWh). Moreover, the savings continued even after the rationing measures ceased. In 2002, overall consumption was no more than the 1998 level, while average residential consumption stood at the 1994 level. Ninety-one percent of households changed their consumption practices during the crisis; of these, 65 percent maintained their new practices after the crisis (ESMAP 2005).

Figure 7.2 Energy efficiency measures reduce power consumption load (%), 2000



Source: Energia Brazil 2002

Figure 7.3 Brazilian households cut energy consumption.



Source: Energia Brazil 2005

An innovative financing mechanism for energy efficiency

In 1998, ANEEL (Agência Nacional de Energia Elétrica), the power sector regulator mandated that 1 percent of utilities' annual net revenues—a "wire charge" —should be invested in a manner that would benefit the public. A 2007 law further stipulated that utilities must use 50 percent of the amount raised through the wire charge for energy efficiency measures aimed at low-income households (World Bank/ESMAP 2005).

From 1998 to 2004[55] utilities invested about $70 million a year in initiatives that successfully curbed demand by 150–500 megawatts (MW). Most projects focused on better efficiency in public lighting (which, in turn, helped municipal budgets) and in households. With proven effects, such investments were an important step toward comprehensive power sector reform (Ibid.).

Linking social protection and energy efficiency

Social protection measures were key to overcoming the 2001–2 power crisis. As noted, low-income consumers lost none of their pre-crisis consumption quota (corresponding to the first block of the tariff structure), but could benefit from the bonus for lower consumption. In addition, power sector reforms required that utilities do more to serve poor customers. For COELBA, the utility serving Bahia state, energy efficiency initiatives led to the legalization and reconnection of old or existing consumers and the extension of service to new consumers, thereby achieving the targets set in the company's concession contract targets (see chapter 5).

Social protection was also at the core of fuel-price reform. Auxilio Gas (AG), a social-protection program established by law in December 2001 to compensate low-income families for the elimination of the subsidy on cooking gas (butane/LPG), started operations in early 2002. As of early 2003, 4.4 million households were receiving the AG subsidy (ESMAP 2008).

Beneficiaries of targeted subsidies, both for electricity and petroleum products, are now identified through one registry: the Cadastro Unico, or Cadúnico. The federal government launched the Cadúnico in 2001 to coordinate the efforts and costs of various social-assistance

[55] Data are not available after 2004.

programs. All energy stakeholders—ANEEL, the power sector regulator, the regional distribution companies, and Auxilio Gas—use Cadúnico's information to identify target groups. Energy subsidies are now managed as part of the overall program of social assistance for low-income groups—the Bolsa Familia—rather than as a separate program (ESMAP 2008).

A program of widespread communication

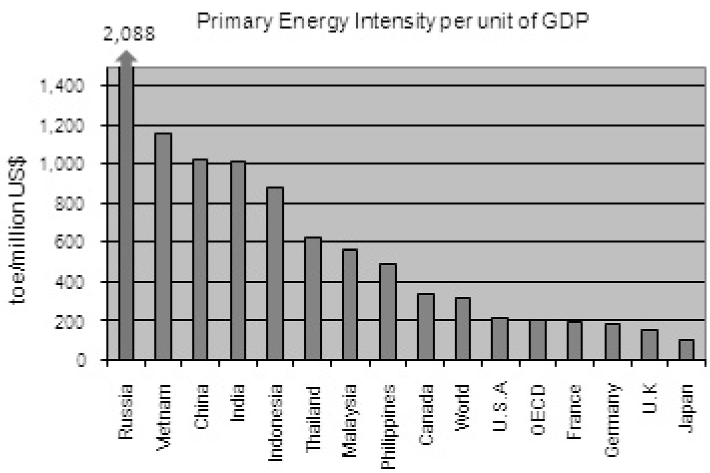
As the crisis of 2001–2 unfolded, the government staged events to inform the public and gather feedback, but the media coverage of these events and of the government's proposals to address the crisis served only to perpetuate the public's confusion. Once the package of measures was well defined, however, ministers appeared on television to explain the quotas and the two-part tariffs. Technical information on how to save energy was broadly disseminated by radio, television, community meetings, and other means. Consumer surveys carried out after the crisis revealed a significant shift in behavior, with 56 percent of households stating that energy efficiency had played a role in appliance-purchase decisions, compared with 8 percent before the crisis (ESMAP 2005).

Japan: Technical Research, Industry Partnerships, and a Multisector Approach

Japan's experience with energy efficiency illustrates the efficacy of long-term government commitment. A net importer of primary energy, Japan has seen a significant expansion of demand linked to sustained economic growth and changes in people's lifestyles. But since the oil shock of the 1970s, Japan has aggressively promoted energy efficiency programs and policies aimed at improving energy management, equipment and process technology, and research and development (R&D).

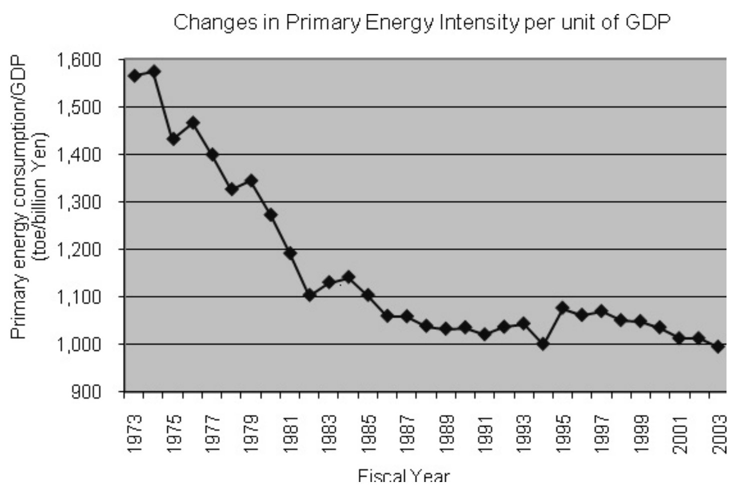
As a result, Japan has among the best ratios of energy intensity in the world (figure 7.4). It has been able to achieve a 40 percent reduction in energy intensity since the early 1970s (figure 7.5), and aims to reduce intensity by an additional 30 percent by 2030 (Limaye et al. 2007).

Figure 7.4 Japan: a leader in reducing energy intensity



Source: IEA database

Figure 7.5Energy intensity in Japan dropped 1973–2002



Source: METI statistics

Japan's policies have combined regulation, supportive measures, corporate energy-conservation management, and public and private sector R&D. The Energy Conservation Act of 1979 (amended many times) focuses on energy efficiency in the industrial, commercial, residential, and transport sectors. Supportive measures include preferential low-interest loans, tax incentives (deductions, special depreciation), and subsidies for enterprises that introduce highly efficient systems into their activities (Ibid.).

The Energy Conservation Center and the Energy Efficiency and Conservation Division of the Agency of Natural Resources and Energy (ANRE) have engaged in a wide range of activities, from product labeling and energy-audit programs to training and the provision of fiscal incentives. Sample programs include:

- *In industry,* programs include the Energy Manager System Program, whereby energy managers are required by law to recommend energy-efficient improvements to facilities, and the Voluntary Environmental Action Plan of Keidanren (the Japan federation of economic organizations), which unites 35 of the most energy-intensive industries in a pact to achieve energy efficiency goals and deliver results. The impact of these programs is impressive (Table 7.1).

Table 7.1 Japan: impact of improved energy efficiency in industry

Effect of Measures and Dissemination Rate of Typical Higher Efficient Equipment for Energy Conservation			
Industry	Improved Energy Intensity (94/73)	Typical Energy Conservation Equipment	Dissemination Rate as of 1998
Iron and Steel	81%	Continuous caster (CC)	100%
		Blast furnace top gas pressure recovery equipment (TRT)	100%
		Coke dry quenching equipment (CDQ)	91%
Petrochemical	58%	High-efficiency naphtha cracking reactor	100%
		High efficiency compressor	100%
		Gas turbine	100%
Cement	65%	SP, NSP kiln (Heat recovery)	100%
Paper & Pulp	61%	Continuous digester	100%

Source: ECCJ 2007

- *In transport and consumer goods,* the Top Runner Program sets fuel-efficiency targets for 21 designated machinery and equipment products, leading to significant reductions in electricity consumption (Table 7.2). The Smart Life Program aims to change the behavioral practices of consumers and children. Other programs include the labeling and ranking of energy-efficient appliances, the spread of hybrid and fuel-cell cars, and the popularization of cars using the "idling stop" system, all developed through strong R&D partnerships with industry. Although their effects on energy efficiency have not been researched in detail, Japan also appears to have made impressive achievements through its highly developed public transport system and facilities for non-motorized transport (such as 37,000 miles of bicycle paths built by the government in the 1970s) (Replogle 1992).

Table 7.2 Japan: improvements in energy savings for selected products

Equipment	Base Year	Target Year	Initial Expected Energy Saving (%) compared to the Base Year at the Target Year	Actual Improvement Energy Saving (%) compared to the Base Year at the Target Year
Air Conditioners (below 4kW)	FY1997	FY2004	63	67.8
TV Sets (Cathode Ray TV)	FY1997	FY2003	16.4	25.7
VCRs	FY1997	FY2003	58.7	73.6
Electric Refrigerators	FY1998	FY2004	30.5	55.2
Electric Freezers	FY1998	FY2004	22.9	29.6
Gasoline Passenger	FY1998	FY2004	22	22

Source: ECCJ 2007

China: Technical Improvements, Industry Involvement, and Public Accountability

China's rapid economic growth—in excess of 9 percent over nearly three decades (1978–2006) has made energy demand-management a policy priority. .In fact, it is one of two key economic indicators in the country's National Development Plan (2006–10), the other being GDP.

From 1980 to 2001, China's energy intensity improved by 68 percent. The Development Research Center (DRC) estimates that total energy savings are nearly twice the incremental consumption over the period since 1980. These are implied savings, estimated by comparing China's elasticity of energy to GDP (0.43) to that of Japan (1.0) in its early stages of industrialization (Berrah et al. 2007).

These savings were possible because of several measures:

- Energy-pricing reforms began in the 1980s and were progressively applied to coal, gas, oil, and electricity. According to some analysts, these reforms account for more than 50 percent of the gains in energy efficiency.
- The efficiency of major energy-intensive industries improved by 20–60 percent, while the truck transport sector registered a 14 percent increase in oil-consumption efficiency.

China recognizes the potential for additional gains. Its energy-intensive industries still consume 25–60 percent more than similar industries in industrialized countries, while its energy system is 10 percent less efficient. Using 2005 levels as a starting point, China aims to reduce its energy intensity by 20 percent by 2010 (Berrah et al.)

To achieve current energy efficiency targets, key government measures include: enforcing the country's top 10 energy-conservation programs, focusing on the top 1,000 enterprises, and monitoring compliance with the Energy Conservation Law. Priority areas include: energy-intensive industries, buildings (with energy consumption per square meter three times higher than in industrialized countries at the same latitudes), transport, and urban planning.

Energy-management companies (EMCs) are China's version of energy service companies (ESCOs).[56] EMCs have grown rapidly since the mid-1990s. The concept of performance contracting was introduced in 1994–5—with support from the government and the World Bank—to promote commercial energy efficiency investment through the growing market economy. In 2006 investments by some 60 EMCs were estimated at $280 million. The profitability of EMCs in the Chinese market has been clearly demonstrated, which explains their continued growth, despite the fact that they must mobilize all financing up front.

EMCs are full-service companies—in charge of all aspects of project development, financing, and implementation. Their functions include:

- Energy efficiency diagnostics and project identification
- Establishment of client agreements on project scope and expected savings (and of the payment stream to accrue to the EMC from those savings)
- Financing of investment based on clients' repayment guarantees
- Equipment procurement and installation
- Commissioning, testing, training, and maintenance in accordance with agreements

The main markets for EMCs are buildings and energy-intensive industries. Typical improvements include renovations of boilers, kilns, and furnaces; recovery of waste-heat and gas; and installation of internal controls. Some EMCs are also equipment manufacturers; quite a few have patented technologies. The more mature EMCs offer full, initial diagnostics (audits) as a means of identifying clients likely to benefit from their products and services.

Maintaining public accountability for the results of energy-efficiency improvements is an important element of government policy in China. Four key indicators are regularly released to the public:

- Energy intensity (energy consumption per unit of GDP)
- The rate of improvement in the energy intensity ratio
- Energy consumption per unit of value added in industry
- Electricity consumption per unit of GDP.

[56] This section draws heavily on annex 7, World Bank/ESMAP 2005.

Indonesia: Success from a Difficult Entry Point

Indonesia provides an example of how to launch an energy efficiency campaign from one of the most difficult entry points—reform of energy-price subsidies. The country's success illustrates how energy-price reform can become an effective means for social development. Indonesia's case is particularly helpful to MENA countries because of its similar context

The context

Historically, Indonesia's government controlled the domestic price of fuels, including gasoline, diesel, and the kerosene used by 90 percent of Indonesian households for cooking. The fuel subsidy—a universal price subsidy—was in fact the centerpiece of Indonesia's social-protection scheme until 2005. Government spending on the fuel subsidy alone was comparable to what many middle-income countries spend on welfare and social insurance. But the subsidy was regressive, with the top income decile receiving more than five times what the bottom income decile received (World Bank 2006).

As oil prices and imports rose and domestic production declined, fuel subsidies swelled from $3.5 billion in 2003 to $7.7 billion in 2004, an election year (Arulpragasam 2007). The looming fiscal crisis prompted the government to act. Learning from failed attempts to increase energy prices—an attempt in 2002–3 caused riots—the government invested in careful planning and preparation.

Removing subsidies and reallocating the savings

Indonesia rolled back fuel subsidies in planned phases over a nine-month period. The process began in December 2004, two months after a new government had been elected. A second increase in fuel prices took place in March 2005. By October of the same year, fuel subsidies had been completely eliminated. The process unfolded without social unrest.

The main reasons behind the success of these difficult policy measures include:

- *Careful planning* before the first announcement of a price increase. Several months were spent studying the magnitude of the problem, including benchmarking the cost of energy subsidies against other countries (Ghana, India, Malaysia, and Morocco) to conclude that Indonesia spent 8–10 times more on energy subsidies than the others.
- *Detailed analysis of options*, including social-protection measures and implementation means. It was determined, for example, that the middle quintile as well as the two poorest quintiles would need targeted support.
- *A carefully designed cash-transfer program.* The government readied an unconditional cash transfer (UCT) program for rollout within two months (by October 2005). Investigators used proxy means testing (see chapter 5) to identify the target groups. The postal system was selected to make the cash transfers because it was familiar and accessible to beneficiaries. The government opted for the risk of overcompensation and overcoverage, rather than

undercompensation and undercoverage. It put a monitoring system in place to obtain immediate assessments of implementation measures.

- *Communication.* A widespread communication campaign was launched, using both broadcast media and printed information (Ibid.).
- *Action.* The UCT took effect on October 1, 2005. Immediately afterward, the government more than doubled average fuel prices and tripled kerosene prices (table 7.4).

Table 7.3 Indonesia: fuel price increases, 2005

	Jan 2003–Feb 2005			Mar–Sep 2005		Oct 2005		
	Floor price	Ceiling price	Fixed price	Price	% change from Feb 05	Price	% change from Mar 05	% change from Feb 05
Gasoline	1,650	2,100	1,810	2,400	33	4,500	88	149
Kerosene (household)	700	700	700	700	0	2,000	186	186
Automotive diesel	1,650	2,100	1,650	2,100	27	4,300	105	161

Source: Arulpragasam 2007.

Indonesia's 2005 UCT was the largest cash-transfer program the world has ever seen, eventually reaching 19.2 million poor households.[57] Its annual budget was $0.5 billion in 2005 and $1.5 billion in 2006. But savings on energy subsidies were estimated at $10.1 billion (Arulpragasam 2007 and World Bank 2006).

Savings from fuel subsidies were immediately reallocated to four critical social- development programs (Blanchard 2008):

- A $650 million program of block grants for schools. The objective was to provide aid to schools in order to reduce family contributions. The size of the grant was based on enrollment: for primary schools, $25/pupil/year; for junior secondary schools, $35/pupil/year.
- A $400 million program of free health services at the public health clinics known as Puskesmas, and free inpatient treatment at third-class hospitals for the poor.
- A $350 million rural-infrastructure program, in the form of block grants to districts for the construction of roads, bridges, and other infrastructure facilities (at the village level, decided by the local community). The funds went directly to village accounts without being funneled through sectoral or district budgets.
- A youth employment program, in the form of training and start-up funds to create small businesses.

A monitoring system to assess implementation performance

Program implementation was monitored with the participation of the Statistical Bureau. In spite of some targeting errors, the program was largely successful. Overall results were satisfactory, the poorest receiving 21 percent of total subsidies and the near-poor (deciles 2–3–4)

[57] Figures in the literature are not fully consistent. They quote the total number of beneficiary households at 19.2 million, suggesting that some may have been eliminated upon reassessment of qualifications.

receiving about 40 percent of total subsidies. The transfer benefits represented about 17 percent of average consumption per capita of the poorest decile and 14 percent of the second decile (Arulpragasam 2007).

Implementing such a program in several months was a challenge to the government. Although performance was good overall, many problems were reported after the first disbursement. The government reacted quickly by commissioning an assessment of all existing problems. This strategy was pursued throughout the program duration. The government realized field assessments, organized public hearings of program beneficiaries, established complaint-resolution mechanisms, and improved the distribution of UCTs at a decentralized level (Ibid.).

Two factors of success are worth highlighting:

- *Communications.* The government undertook a widespread information campaign that included TV and radio talks, newspapers, and brochures. This strategy helped avoid public protest against price reform. But it also led to a surge of applicants, making it increasingly difficult for the administrators to identify eligible households.
- The transition's limited duration. The government made it clear that the program was time bound. In 2007, it replaced the UCT with a conditional cash-transfer program.

Jordan: New Legal and Financial Frameworks, Plus Effective Communications

With a tradition of highly subsidized domestic prices, Jordan is fairly representative of net oil–importing countries in MENA. Imports of oil and natural gas represent around 95 percent of its total energy consumption. Table 7.4 below also shows that Jordan has the second highest consumption of oil per capita, as compared to neighboring countries. By 2007, oil imports accounted for 14 percent of GDP. The 2003 invasion of Iraq, however, terminated Jordan's preferential import arrangements with Iraq, and jeopardized its energy security. As the continuing trend of rising oil prices increased the fiscal impact of subsidies to very risky levels, the government of Jordan embarked on a new energy strategy that includes energy-supply diversification, the elimination of energy-price subsidies with social protection, a new law on renewable energy and energy efficiency, and a new communications strategy.[58]

[58] The information in the following section is drawn from a presentation by Mr. Metri Mdanat, Ministry of Finance. Tunis Workshop. November 2008, as well as from information collected by World Bank staff during the preparation of an internal assessment of the impact of energy price increases in Jordan.

Table 7.4 Oil consumption per capita in Jordan and neighboring Countries

Country	Population (Million)	barrel per person
Lebanon	4.0	9.74
Egypt	81.7	2.84
Syria	19.7	4.23
Tunisia	10.4	3.16
Jordan	6.2	6.42

Source: Metri Mdanat, Tunis Workshp. November 2008

Elimination of fuel price subsidies with social protection

The government of Jordan eliminated oil subsidies in 2008. It is remarkable that Jordan's internal oil-price liberalization was accomplished without social upheaval.

Starting in the early 1990s, the government of Jordan fixed the retail price of oil and implemented a subsidy system, financed from the government's budget, in an effort to insulate the domestic market from fluctuations in international oil prices. After March 2003, Jordan lost its preferential oil-import arrangements with Iraq, and started gradually paying international prices for oil imports. With rapidly increasing international oil prices, the oil subsidy jumped from $60 million in 2002 to $749 million in 2005, representing 15.3 percent of government expenditures and 5.9 percent of GDP. This prompted the government to gradually reduce the subsidy, starting in September 2005, and to announce further measures to eliminate it in 2008. The government estimated that subsidies would have reached about $1–1.3 billion if maintained through 2008 (5.6–7.2 percent of GDP), raising the fiscal deficit to over 14 percent of GDP.

Analysis documented that subsidies were regressive. The top income quintile captured 44 percent of the subsidy, while the lowest quintile received only 8.9 percent. As the poor spend a higher share of their income on fuel products,[59] the government had to take into consideration the impact of subsidy removal on the poor.

The elimination of fuel subsidies was progressive and included a package of social-protection measures. Gasoline subsidies were fully eliminated in February 2008, but subsidies on diesel

[59] The poorest 13 percent of the population allocate 35 percent of their expenditures on fuel products, compared to 26–28 percent for the nonpoor.

(used for heating and transport) were maintained until the end of March; that is, until the end of winter. To offset the price increase, the government financed a compensation package that included:

- *A salary increase to government employees of $64–71 per month.* Employees with salaries below $424/month received an increase of $71/month, while other employees received an increase of $64/month.
- *One-time targeted cash assistance for households, aimed at private sector employees and retirees with an annual per capita income below $1,412.* The Ministry of Finance estimated that about 1.8 million individuals (around 30 percent of the population) would benefit from the one-time cash assistance program.[60]
- *An increase in monthly cash assistance,* under the National Aid Fund (NAF), from $37–47 to $51 per month (47 percent of NAF beneficiaries were among the poorest).

Table 7.5 Distribution of cash assistance ($)

Cash assistance per individual (yearly)	Conditionality 1: per capita household income (yearly)	Conditionality 2: assistance not to exceed (per household)
35	<565	212
21	566–1,130	127
14	1,131–1,412	85

Source: Official data

- *Protection of low-income electricity consumers through cross-subsidies.* The tariff increase for the lifeline consumption level (the first 160 kilowatt hours) was 3.2 percent, compared to 24 percent for the average tariff (appendix, Table 1).
- *Tax exemptions aimed at low-income groups in 2008*, including the removal of custom duties and the general sales tax (GST) on 13 basic food items.
- *Increase participation in the national health insurance program* for lower income families.
- *Building housing units* for the poor.
- *Economic protection* for key services and small and medium enterprises (SMEs), such as the removal of the GST for non-tourist restaurants and a temporary GST exemption for retailers with an annual turnover below $1,400,000, as well as for taxis and public transport.
- *Measures aimed at fuel substitution and energy efficiency*, including the elimination of sales tax on solar energy and all energy-saving equipment. The new National Energy Efficiency Strategy aims to reduce energy consumption without negatively affecting economic growth or the standards of living; to improve the balance of payments between the value of exports and the value of energy imports; to reduce the production costs and improve the competitiveness of local industries and other sectors; and to improve efficiency in the production, transformation, transport, and distribution of energy.

[60] The program is administered by the Income Tax Department in the Ministry of Finance.

As summarized in table 7.6, the total cost of the 2008 compensation package was estimated at $679 million for 2008 (3.8 percent of GDP) in direct budget outlays; the foregone tax revenues at $50 million (0.2 percent of GDP).

Table 7.6 Jordan: Budgetary compensation package, 2008

2008 Budgetary Compensations	Items	Amount in US$	% Share in expen. or reven.	% share in GDP
Expenditures				
Subsidies	Total	561.0	7.2	3.1
	Fodder subsidy *	165.0	2.1	0.9
	Cooking gas subsidy *	65.0	0.8	0.4
	Wheat subsidy *	247.0	3.1	1.4
	Barely subsidy *	28.0	0.4	0.2
	Compensation to cattle owners **	28.0	0.4	0.2
	Incentives to grow wheat and barely on new land **	28.0	0.4	0.2
Wages & Sal./Social Safety Net	Total	621.0	7.9	3.4
	Salary increase to public servants and military personnel	501.0	6.4	2.8
	One time assistance to private sector employees	56.5	0.7	0.3
	Increase in the National Aid Fund compensation	10.6	0.1	0.1
	Other	52.9	0.7	0.3
Revenues				
Tax Exemptions	Total	50.0	0.6	0.3
	GST and customs tax exemption for 13 basic food items	24.3	0.3	0.1
	GST for non tourist restaurant	7.1	0.1	0.04
	Special tax exemption on cement	7.1	0.1	0.04
	Temporary GST exemption for retailers with taxable turnover of less than US$140,000	2.8	0.0	0.02
	Customs tax exemption for solar energy, gas and water heating equipment	8.8	0.1	0.05

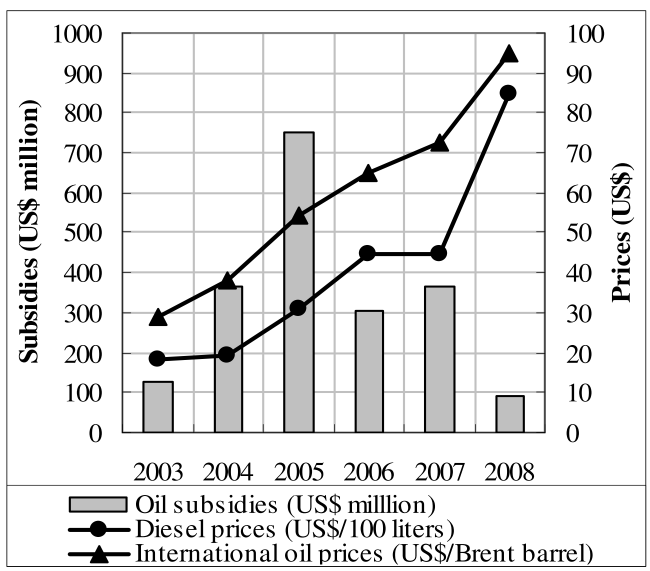
* These subsidies have been introduced earlier and maintained in 2008 budget.

** These subsidies have been introduced in 2008.

Source: Official data and Word Bank staff calculations.

This decision resulted in an increase in prices of oil derivatives between 3 percent (unleaded gas) and 110.9 percent (fuel oil for electricity) in February 2008 (Figure 7.6). The government has adjusted local prices to follow international prices through further monthly increases in the oil prices since February 2008 (appendix, Table 2).

Figure 7.6 Domestic price increases limit subsidies



Source: Official data and World Bank staff calculations.

Savings will fund public sector salaries. In 2008, oil subsidies are expected to be limited to 0.9 percent. By the end of 2008, savings from the oil subsidies since 2005 (about 5 percentage points of GDP) will have been almost entirely directed toward higher wages and salaries of public servants and military personnel (4.6 percentage points). The government of Jordan, however, acknowledges that these transfers are an imprecise method of compensating for price increases, and is considering (a) undertaking more systematic analysis of the impact of price changes on the poor and vulnerable, with the goal of compensating them more accurately for their loss in welfare; and (b) improving the targeting of the NAF. Both would be with assistance from the World Bank.

The 2004-7 price increases had a limited impact on the competitiveness of the manufacturing sector and on company profits. Agriculture and transportation are among the sectors most directly exposed to higher oil prices. Exposure of other sectors is mainly indirect, including through higher transportation costs and electricity prices. Higher export prices somewhat mitigated the adverse impact of fuel price increases on company profits (table 7.7).

Table 7.7 Jordanian industrial products remained competitive, despite energy price increases, 2004–7

Industries	Percentage of real GDP	Wholesale price increase 2004–7 (%)	Export prices increase 2004–7 (%)
Phosphate	1.1	n.a	71.7
Potash	1.0	n.a	71.7
Fertilizers	2.2	7.6	80.3
Pharmaceuticals	0.9	3.9	80.3
Cement and lime	0.7	14.2	n.a
Iron and steel	0.6	14.2	n.a
Wearing apparel and textiles	0.6	4.9	35.2
Food products	3.2	51.5	63.6
Total	10.4	25.2	69.5

Source: Official data and Word Bank staff calculations.

The services and trade sectors are particularly exposed to the spillover effects of eliminating energy subsidies. According to preliminary estimates, commercial establishments and hotels are likely to see their electricity bill increase by 36.5 percent and 43.3 percent respectively. There is also a risk of reduced competitiveness of exports in international markets.

The 2008 increase in oil prices and electricity tariffs is likely to have a more important impact on production costs and inflation. Based on the latest available data, the consumer price index (CPI) increased by 6.5 percent between January and February 2008, and may hit double-digit levels in 2008, compared to inflation of 5.4 percent in 2007.

The political economy of fuel-price reforms

There are three major socioeconomic groupings in Jordan that require special attention: farmers, transport sector operators, and civil servants and military personnel. These are either highly sensitive to oil-price increases and/or sufficiently large and organized to initiate a protest movement. Farmers and the transport sector rely on petroleum products as a direct input. They refrained from reacting to recent fuel-price reforms most likely for three reasons: (a) agriculture is a small sector (3 percent of GDP) and the proportion of farmers in the population is small (3.1 percent of the labor force); (b) they receive sizable water subsidies and directly benefit from the domestic food subsidies and high prices on export markets; (c) the government dealt carefully with the transport sector (8 percent of the workforce) by allowing taxi drivers to increase their fares (23 percent on average)[61] as well as by increasing fares in public transport (Hazaimeh, 2008); and (d) civil servants and the military (which represents a large and well-organized portion of the workforce) received wage/salary increases (including one-time increases) throughout the period of gradually adjusting oil prices (2005–8). Furthermore, since a large share of disposable income in Jordan consists of foreign income and remittances, household income is somewhat insulated from the removal of the oil-price subsidy. For example, worker remittances and net foreign income inflows grew by 24 percent in 2007 alone, amounting to 22 percent of GDP. This increase is equivalent to $666 million, compared to the 2007 oil subsidy of $367 million.

Communication essential to reform success

The new prime minister interacted with various interest groups to discuss the proposed plan to eliminate fuel subsidies. These groups included members of parliament, local nongovernmental organizations (NGOs), the business community, and labor representatives. The emphasis was put on the regressive nature of the oil subsidy and subsequent leaks to higher-income groups. A media campaign in 2007 prepared the ground for subsidy reform: local newspapers wrote on the economic benefits of eliminating fuel subsidies and provided some information on compensation schemes the government was considering. In sum, the elimination of the oil subsidy did not come as a shock to the general public or policy makers.

Jordan and Indonesia Compared

Table 7.8 compares the main elements of fuel-price reform in Jordan with those of Indonesia. Although there are some differences, both countries succeeded in implementing fuel-price reform without prompting social unrest. There are many common points in the criteria for success, in particular, careful planning and analysis of reform options, targeting of groups and budget needs prior to launching the reforms, significant communications campaigns, and a comprehensive package of social-protection measures to offset the potential negative impacts of reforms on target groups.

[61] By matter of comparison, taxi drivers in Lebanon were behind a major strike in the spring of 2004 against the increase in the prices of oil products. The strike ended in riots that claimed the lives of several people and the government had to put a cap on oil prices by reducing taxes on oil products in parallel to the increase in international prices.

Table 7.8 Benchmarking Jordan and Indonesia

	Jordan: February 2008	Indonesia: 2005
Objective : Reduce the impact of energy subsidies	Subsidies : $749 million, or 15.3% of government expenditures in 2005	Subsidies = $9.87 billion in 2005
Fuel-price increases	From 3 to 76 %, depending on grade	March 2005: 27–33 % October 2005: 160–240 %
Price indexation	Indexation maintained for 2008–10, then full-scale liberalization	Indexation formula adopted in 2002, abandoned in 2003 because of political opposition; full liberalization in 2005
Compensation package		
Budget	$621 millions in 2008 + $50 million of foregone tax revenues	$3.5 billion in 2005–6
Social protection		
- Cash transfers	To 4,400,000 (base 2006) people with family income of less than $1,412	To 15.5 million people
- Salary increase for civil servants and the military	X	
- Grace period of full price increase	LPG until end of winter	
Economic protection		
- Tariff for taxis and public transport	X	
Institutional measures	**Jordan**	**Indonesia**
- Information campaign - Robust analytical work	X Ex ante analysis of impact on income groups and some economic groups	X Ex ante estimate of impact on inflation, on budget, and on different income groups
Institutions involved in cash transfers	Government Banks	Government Central bank Post office
- Price inspectors	** in gas stations to avoid speculation on stocks	

Source: World Bank staff

Conclusion

This chapter reviewed five national experiences with energy efficiency goals – Brazil, Japan, China, Indonesia, and Jordan – to illustrate the wide range of approaches and issues involved in implementing policies that improve the rational production and use of energy. The case studies highlight many common points across countries, some of the most salient being the time commitment needed to achieve results, the need to consult and communicate with stakeholders, and the importance of comprehensive packages of measures (economic, social, institutional, financial, and technical). Specific lessons from each country are listed below.

From Brazil

- A long-term commitment is necessary. More than 35 years after initiating its first energy-conservation and energy-efficiency programs, Brazil is still striving to improve performance.
- Price signals are effective incentives for energy efficiency. The price-signaling approach, developed in 2001–2, positively affects both short- and long-term results.

- A politically and relatively palatable solution to applying price signals is needed—for example, a baseline consumption level or quota for each main category of consumer. An added incentive for energy efficiency is to reward under-consumption with a bonus.
- Energy efficiency, pricing reform, and social protection go hand in hand. The experience of Brazil also shows that the poor can contribute to energy savings. Their welfare improves as they spend less on energy and retain more income for other needs.
- Energy efficiency and social protection can be a win-win solution for utilities as well.
- Widespread communication campaigns on energy efficiency are needed to obtain sustainable results.

From Japan

- Clear and long-term government commitment yields substantial results.
- Economic pricing of energy can be balanced with rewards to industries undertaking energy-efficiency programs.
- Targeting key consuming sectors simultaneously, but with well-tailored programs, helps achieve faster results.
- Sustained R&D, in partnership with the private sector, can help deliver technology and technical solutions.
- For future generations, energy efficiency starts with early primary education.

From China

- A long-term government commitment is needed to reduce the economy's energy intensity through improved energy efficiency in industry and major consuming sectors. This is true even for sectors in the early stages of industrialization.
- Price signals help facilitate energy-efficiency investments.
- Models of service providers, such as ESCOs or performance contractors, must be adapted to local conditions.
- Public accountability, including reporting on results and performance indicators, is integral to a successful reform effort.

From Indonesia

- With intensive analysis and planning, it is possible to implement significant energy-price reform over a short period of time, and to correct the regressive characteristics of a universal price subsidy.
- Widespread information campaigns can be used to identify potential beneficiaries and avoid social unrest.

- Reaching a large proportion of a country's poor households with UCT is possible, provided well-adapted local infrastructure is used.
- Monitoring makes it possible to take corrective action early in program implementation.
- Reallocation of savings from energy subsidies can be used to extend social-development programs targeting the poorest citizens.

From Jordan

- Reforms are best introduced in a favorable economic environment. Jordan experienced strong economic growth during the reform period; high export prices in particular helped cushion the impact on domestic producers.
- Careful planning and the robust analysis of stakeholder groups, options, and budgetary needs must take place before reform measures are announced.
- Stakeholder consultation and participation foster broad-based commitment to reform.
- Well-designed social-assistance and "economic protection" schemes help mitigate impacts on consumers *and* producers.
- Unless social benefits are accurately and narrowly targeted, fiscal savings from energy efficiency can be easily dissipated.

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Appendix 7.1: Jordan Price and Tariff Changes

Table 1. Jordan: Changes in electricity tariffs

Electricity tariff structure (Fils—1JD = 100 fils)

Bracket / sector	Before elimination of oil subsidy	After elimination of oil subsidy	% change
Dwelling [1–161] Kwh	31	32	3.2
Dwelling [161–300] Kwh	59	71	20.3
Dwelling [301–500] Kwh	67	86	28.4
Dwelling [>500| Kwh	82	113	37.8
Commercial	63	86	36.5
Hotels	60	86	43.3
Radio/TV	61	86	41.0
Small industry	41	49	19.5
Medium industry (day)	28	49.2	75.9
Medium industry (night)	30	49.2	64.1
Large industry	—	64.5	—
Agriculture	31	47	51.6
Water pumping	40	41	2.5
Street lighting	30	35.3	17.6
Armed forces	67	77.0	14.9
Port	46.6	58	24.5

— = data not available.
Source: Official data and World Bank staff calculations

Table 2. Jordan: The change in the prices of oil derivatives (Prices are in JD)

Item	2004	2005	% change 2005 / 2004	2006	% change 2006 / 2005	Feb. 2008	Mar. 2008	% change 2008 / 2006
Super/liter (replaced by unleaded 95)	0.435	0.505	16.1	0.605	19.8	0.66	0.665	9.9
Unleaded/liter (replaced by unleaded 95)	0.47	0.545	16.0	0.64	17.4	0.66	0.665	3.9
Regular/liter (replaced by unleaded 90)	0.33	0.385	16.7	0.43	11.7	0.575	0.585	36.0
Kerosene/liter	0.135	0.22	63.0	0.315	43.2	0.555	0.6	90.5
Diesel/liter	0.135	0.22	63.0	0.315	43.2	0.555	0.6	90.5
Heavy oil used in electricity plants/ton	75	100	33.3	165	65.0	348	374	126.7
Gas/cylinder	3.25	3.75	15.4	4.25	13.3	6.5	6.5	52.9

Note: 1 JD = $1.412.
Source: Official data and World Bank staff calculations

Chapter 8: Realizing the Potential for Technical Improvement at the Sector Level

Using examples from around the world, we showed in chapter 7 that countries that had significantly improved their energy efficiency had done so by building a strong economic and institutional foundation for the purpose. This chapter focuses on the microeconomic level of the energy efficiency challenge. To analyze how incentives and regulations apply to sectors of the economy, to firms, and to households, we ask several important questions: What does it mean to improve technical energy efficiency at the sectoral level? What are the potential gains from technical improvement? What are the obstacles, and how can we overcome them?

It is often argued that energy efficiency gains are possible only when an economy shifts toward less energy-intensive sectors. But the experience of Japan demonstrates that this need not be so, and that, when applied within any sector, the principles of energy efficiency can indeed lead to a significant reduction in energy intensity.

This chapter discusses sector-specific options and technologies for improving energy efficiency. It makes three main points:

- The solutions chosen today determine the profile of energy efficiency tomorrow.
- To effectively improve energy efficiency, it is necessary to mobilize the major consuming sectors.
- Energy efficiency investments have high returns, both in the short and long term.

This chapter begins with a brief word on the impact of demographic change on sectoral energy use. The following sections address energy efficiency in four sectors: manufacturing, construction, transport, and irrigated agriculture. The first three were selected because of their significant contribution to energy consumption and, consequently, their substantial impact on overall energy intensity. Irrigated agriculture was chosen because of the significant proportion of poor people involved in agriculture in the region, the importance of efficient water and energy use in increasing agricultural productivity, and the close policy link between energy use and food prices.

Demography and Sectoral Energy Demand

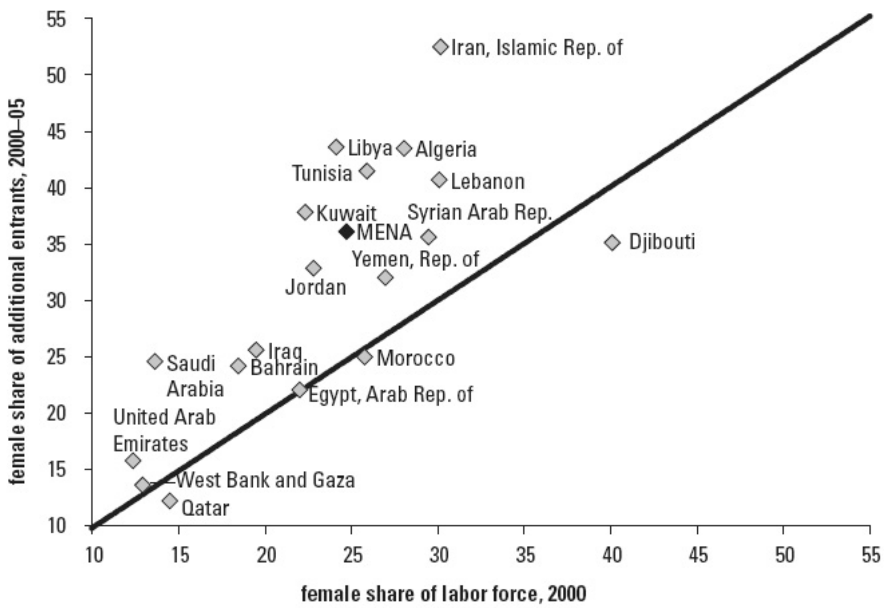
Three demographic processes usually drive major changes in the demand for energy products and services: urbanization, the increased participation of women in the labor force, and mobility.

MENA has already reached a high rate of urbanization—57 percent overall (WDI database). Urbanization entails not only accelerated housing demand, but also greater use of energy-intensive services such as water, transport, electricity, and gas. An Energy Sector Management Assessment Program (ESMAP) survey published in 2005 confirmed that energy efficiency had been neglected in urban planning since the mid-1980s (ESMAP 2005b). In MENA, the evolving form of cities and towns, both old and new, confirms these concerns. Morocco, which needs to provide at least 200,000–300,000 new housing units each year, may be the first country to undertake an urban-planning strategy that addresses energy efficiency.

The increased participation of women in the labor force is also creating changes in the demand for manufactured products and services. Between 2000 and 2005, women's labor grew by 5.2 percent, as their share in the labor force increased from 25 to 27 percent. Women's share of new entrants to the labor force increased from 32 percent to 36 percent in 2005 (figure 8.1).

Figure 8.1 Women are increasingly participating MENA's labor force

b. Women as share of labor force in 2000 vs. women's share of additional entrants to labor force in 2000–05



Source: World Bank staff estimates based on ILO 2005.

With less time in the household, the demand for processed food products—such as precooked couscous in Morocco—is increasing, shifting the demand for energy from households to agroindustries. This has led some connected industries to change their product lines, and to improve energy efficiency in order to make the new products affordable (box 8.3). Women's growing participation in the labor force is also increasing the demand for convenient and affordable urban transportation.

The third demographic factor is mobility. As the labor market expands, there is a necessary increase in inter- and intraregional migration, as well as inter- and intra-city transport. This, in turn, tends to increase demand for more energy-intensive manufactured products and increase mass transit and motorized transport services.

Manufacturing: Benefits for Countries that Can Build Private-Public Programs

Manufacturing in 2005 accounted for 13% of MENA's GDP and 17% of its exports (WDI database). In ESCWA countries[62] particularly well endowed with primary energy resources, the four most energy-intensive manufacturing industries are cement, steel, fertilizers, and glass, consuming 25 percent of the energy and contributing a significant share of GDP (box 8.1).

Box 8.1 Key manufacturing industries require high energy input

Cement production is a major industry, largely because the region's oil-driven construction boom has boosted demand. Cement production accounts for about 10 percent of the energy consumed by the industrial sector, and the energy efficiency of cement industries in ESCWA is low compared to the international average (exceeding it by 150 percent in some countries). Substantial improvements in energy efficiency could be obtained by streamlining the manufacturing process, reducing the clinker in the mix, and using alternative fuel resources. While petro coke has been increasingly used in cement production around the world, in MENA only Holcim and Sibline Cement of Lebanon have started using this fuel, despite abundant resources in Egypt, Kuwait, and Syria.

Steel is one of the most energy-intensive industries (at 600 kgoe/ton), although energy-consumption rates vary depending on the production technology. Several ESCWA countries import semi-processed materials for steel production, thus diminishing energy consumption. Gas is the predominant fuel in the region.

Fertilizer manufacturing is widespread in MENA because of the abundance of local raw materials: phosphates in Egypt, Jordan, Morocco, and Syria; potassium chloride in the Red Sea (with reserves estimated at 2 billion tons); and natural gas. In 2003 ESCWA members produced 5.4 percent of the global supply of ammonia, 7.8 percent of urea, and 4.6 percent of potash. Fertilizer manufacturing is highly energy intensive; for example, 1 ton of fuel per ton of nitrogen fertilizer.

Glass manufacturing is another energy-intensive industry, with an average requirement of 500 kg of fuel per ton of glass, depending on the type of glass (fiber glass requires 1,145 kgoe/ton).

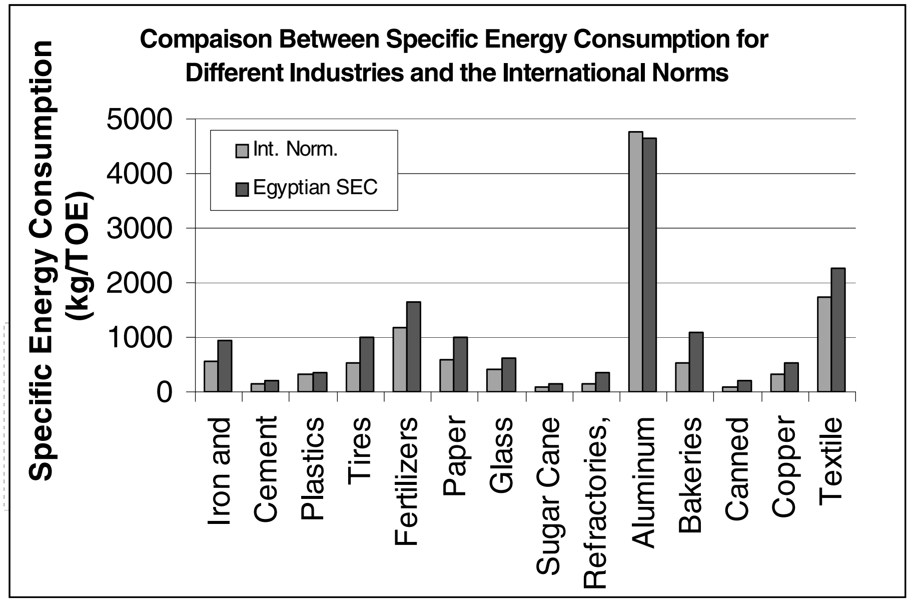
Source: ESCWA 2005.

The aggregate energy intensity of manufacturing (energy use divided by value-added) is a function of the sector's industrial composition and of the energy efficiency of individual sectors or enterprises. To understand energy efficiency in manufacturing, therefore, one must establish the sector averages for energy intensity and benchmark country-level or firm-level performance against international standards. Egypt did this in 1989 at the start of the Energy Conservation and Environment Project (ECEP)[63] (figure 8.2), and was thus able to identify sectors which matched international norms (e.g. aluminum) and those which fell short.

[62] Bahrain, Egypt, Iraq, Jordan, Kuwait, Lebanon, Oman, Palestine, Qatar, Saudi Arabia, Syria, the United Arab Emirates, and Yemen.

[63] The project was completed in 1998. Unfortunately, there is no assessment available of the profile of the concerned industries to compare the energy-efficiency results with the initial situation.

Figure 8.2 Egypt: Status of energy consumption in various industrial sectors



Source: ECEP data

Returns on industrial energy efficiency programs are usually quite high. The payback period is relatively short, and energy savings can be significant (table 8.1). Typical payback periods for Energy Conservation and Efficiency Project investments in Egypt were 2.5 to 4.5 years. The Tunisian Government estimates that its industrial sector energy program has saved 8% of the sector's total energy use. By spending 18 million TD in investment aids, it calculates that it is recouping 83 million TD per year in saved subsidies [64]. In Morocco, estimated energy savings in the industrial sector are 15–20 percent of current consumption. In Jordan the estimated potential for cogeneration is around 150 megawatts (MW) for the industrial sector and around 50 MW for the commercial sector.

Box 8.2 Egypt - Combustion control at Araba Pharmaceutical Glass (APG)

The Energy Conservation and Environment Project provided APG's amber furnace with a complete combustion control system with parallel control with cross-checking for both air and fuel, oxygen sensors for trimming the oxygen in the exhaust gases, a pressure sensor to control furnace pressure, and two air-blast nozzles to ensure the reliability of burner operation. The total cost of the system was $168,049.

The fuel consumption of the furnace dropped from 252.4 kg of HFO/ton of glass to an average low value of 160 kg of HFO/ton of glass. The payback period was 2.8 years. Additional benefits included improvements in glass quality and seed number (the latter by 20 percent), and reductions in emissions of carbon dioxide, sulfur dioxide, nitrogen oxides, and unburned hydrocarbon.

Source: ECEP documentation

[64] Calculated from figures presented to May 2008 World Bank supervision mission

Table 8.1 Egypt: Examples of energy efficiency projects

Project	Technology	Investment cost ($)	Energy savings	Payback period (years)
Furnace and boiler tune-up program for 200 companies	Combustion and gas analyzers		7% in private companies + 12% in public companies	
Arab Aluminum Co.	Regenerative burners and high-quality refactories in furnace	1,085,300		2.5
Egyptian International Pharmaceutical Industries Co.	Installation of a microprocessor-based energy-management system	459,000	179 tons of fuel 2.5 million per kilowatt-hour (kWh) = 30% of total energy cost of the plant	2.3
Alumisr Co.	Cogeneration unit	540,000	L.E. 360,000	4.5
Cairo Beverage Industry Co.	Installation of power-factor-correction equipment	53,000		3.4
El Rashidi Elmizan for Sweets	Waste-heat recovery	188,000	51, 426	4.2

Source: ECEP documentation

Energy-efficient manufacturing processes also offer opportunities to develop partnerships among industrial groups and the public and private sectors. Large industry groups, such as the cement and steel industries, have well-established international associations that facilitate the exchange of information and benchmarks. Associations such as the Association de la Zone Industrielle d'Izdihar in Morocco are at the frontier of innovation (box 8.3). In some countries, partnerships between the public sectors in charge of energy efficiency and industrial groups provide incentives for industries to engage in energy efficiency. Business development service programs, such as the Euro-Med Business Centers, can provide an entry point for energy efficiency advisory services.

Box 8.3 Agro-enterprises in Morocco step up efforts towards better energy efficiency

Enterprises in the industrial zone of Izdihar, mostly agro-enterprises, established the Association de la Zone Industrielle d'Izdihar, Casablanca, and mobilized funding from the Energy Sector Management Assistance Program (ESMAP) for technical assistance, the Global Environmental Facility (GEF), and the Fonds Français pour l'Environnement Mondial (FEM) for energy efficiency investments. After 2.5 years of operation, results include 50 walk-through audits, 21 detailed audits, creation of an energy service company (ESCO), and 20 industrial units engaged in major investments of over $6 million, yielding annual savings of almost $4 million. Examples of energy-efficiency projects include improvement of compressed-air production systems, increased efficiencies in cooling and heating, use of waste heat, and use of energy-recovery systems. The money saved from these projects went into a Social and Environmental Fund that supports increased energy-efficiency awareness and education, public transportation, and industrial waste collection at the site.

Projects that were low cost or had short payback periods were generally funded through companies' own capital resources; projects with paybacks of two to three years requiring investments of more than $100,000 were financed by traditional bank loans. A key challenge in Izdihar was the length of time needed to gain access for energy audits due to mistrust and difficulty in mobilizing industrialists.

Source: ESMAP 2005a.

Construction: A Short-Term Priority with Long-Term Impact

In MENA, the construction sector is a priority for energy efficiency initiatives. Rapid population growth and urbanization have raised demand for housing and infrastructure—including schools, hospitals, and municipal buildings. Buildings today are estimated to consume at least 40 percent of the energy in most countries of the world (WBCSD 2007), and this figure is rapidly increasing in developing countries.

Construction investments span centuries. Therefore, the energy choices made by today's construction industry determine countries' energy profile for many decades. The energy cost of housing and other buildings is also critical from the perspective of household budgets, enterprise costs in the service industries, and fiscal expenditures on public buildings.

The scope for cost-effective investments in energy-efficient buildings is broad. An analysis of payback periods in nine MENA countries[65] (and their capital cities) highlights good business opportunities throughout the region. Payback periods of investments in compact fluorescent lamps (CFLs) range from around two months in Morocco, Israel, and the Palestinian territories to just over seven months in Syria and Egypt. For solar domestic water-heating systems, the payback period is less than three years in five of the eight cities observed (Rabat, Tunis, Jerusalem, Amman and Beirut) when substituted for diesel, and from just one to two years when substituted for electricity. Other cost effective investments include building insulation – particularly as an integral part of wall structures at the moment of construction – solar heating for pools and energy efficient appliances such as non-frost refrigerators and automatic washing machines. Appropriately orienting edifices to obtain a reduction in both cooling and heating load has an immediate payback ratio, but is of course limited to new building projects (Al-Taher 2007).

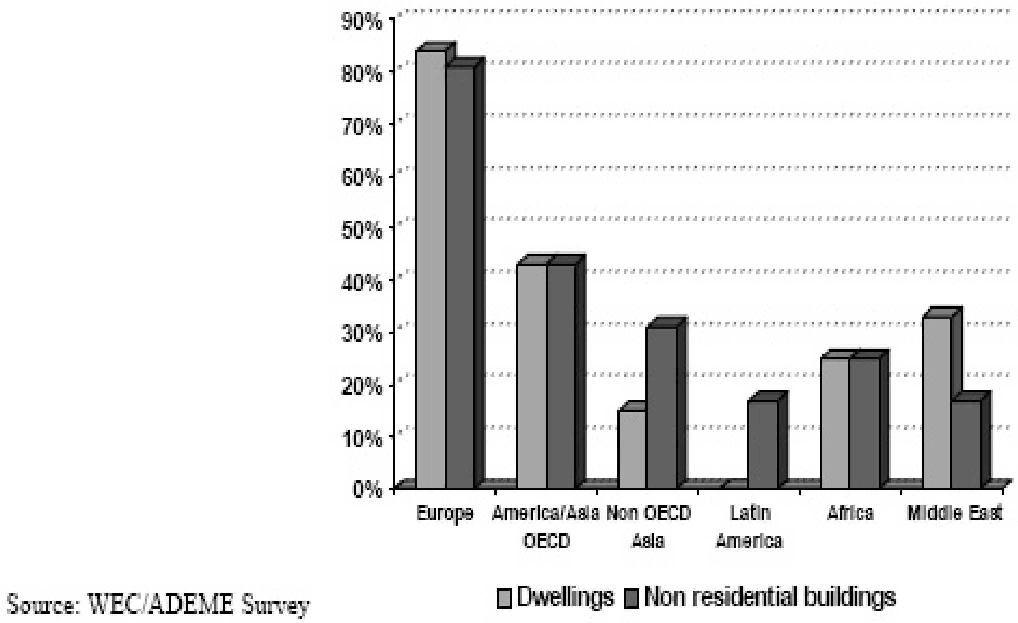
In order to improve energy efficiency in the construction industry, countries should enact and enforce regulations targeting key technical opportunities.

Regulation. Effective regulation can raise energy efficiency. Europe leads the way, with almost 90 percent of new buildings subject to energy efficiency standards (figure 8.3). Relative to other middle-income countries, MENA is in a favorable position. Algeria, Egypt, and Syria are among the first countries not in the Organization for Economic Co-operation and Development (OECD), along with Singapore and the Philippines, to have mandatory or voluntary standards for service buildings. Algeria and Egypt, like China, have implemented standards for both dwellings and service buildings (World Energy Council 2008)[66].

[65] The study focused on the nine MENA countries members of the Euro-Mediterranean partnership, i.e. Morocco, Algeria, Tunisia, Egypt, Israel, Palestinian territories, Jordan, Lebanon and Syria. The study also included Turkey (Al-Taher, 2007).

[66] Service buildings are those in which some type of service is provided other than food service or retail sales of goods. In the US they represent 7% of commercial buildings' energy consumption (eia.doe.gov, 19 June 2008).

Figure 8.3 Percentage of countries with energy-efficiency standards for new buildings, by region



Source: WEC 2008.

MENA is now at a critical juncture. At least half of its countries are in the process of updating, drafting, or adopting new energy-efficient building codes (table 8.2). Some of the codes, however, have not yet gone into effect, while others apply to new buildings only, and few govern the rehabilitation of existing buildings. Enforcing construction codes is also an issue. It is necessary to support and increase the capacity of the building consultants, companies, and local authorities responsible for enforcing these codes. Such activities are still in their early stages in the region.

Technical solutions. A recent market assessment (Chaaban 2007) of energy efficiency in buildings of four MENA countries—Algeria, Tunisia, Morocco, and Egypt—provides an overview of measures and initiatives to integrate energy efficiency in buildings. High-efficiency lighting, as well as roof and wall insulation, has proven the most promising. High-efficiency lighting is increasingly found in new buildings in Morocco as well as in new commercial and government buildings in Egypt. It is also a mature technology in new and existing buildings in Tunisia. Roof and wall insulation is widespread in Algerian buildings and in new buildings in Tunisia (box 8.4).

Table 8.2 Status of energy-efficiency building codes in MENA

Country	Energy-efficiency building code
Algeria	Code in place for both residential and service buildings
Egypt	Codes for residential and commercial have already been developed. Code adoption is still voluntary
Israel	Code in place
Jordan	Building code for residential buildings in place
Lebanon	Draft code developed; adoption pending
Morocco	Code under development
Syria	Code in place for service buildings
Tunisia	Code in place

Source: Heffner 2008

Under the MED-ENEC program,[67] energy-efficiency projects have begun across the nine Arab Mediterranean Partner Countries (MPCs) above mentioned, plus Turkey (table 8.3).

Table 8.3 Energy-efficiency improvements in the construction industry in MENA countries under the MED-ENEC program

Implemented measures/technologies in MED-ENEC pilot projects	ALG	EGY	ISR	JOR	LEB	MOR	PAL	SYR	TUN	TUK
Energy efficiency										
Insulation	■	■	■	■	■	■	■	■	■	■
Shading	■	■	■	■		■	■	■	■	■
Efficient lighting	■	■	■	■	■	■		■	■	■
Wind towers			■							
Night vent and thermal mass	■					■	■			
Solar chimney								■		
Demand-side management					■					
Renewable energy	ALG	EGY	ISR	JOR	LEB	MOR	PAL	SYR	TUN	TUK
Solar Water Heat	■			■		■		■		
Solar space heating	■							■		
Solar cooling		■		■						
Solar air collector									■	
Evaporative cooling				■						
Photovoltaic			■						■	
Geothermal energy									■	
Heat pump					■	■				■
Wind turbine			■							

Source: Wenzel 2008.

Box 8.4 Tunisia: Thermal efficiency in buildings

The 2006–2008 Action Plan of the Agence Nationale de la Maîtrise de l'Energie (ANME) related to the residential and tertiary sectors includes six major tasks (MED-ENEC 2006):

- Conduct the first phase of the implementation of thermal legislation pertaining to new buildings
- Design a program for the rehabilitation of existing buildings
- Develop programs for the spread of efficient equipment
- Revitalize audits and program, with contract audits in the tertiary sector
- Create and reinforce a system for the promotion and exchange of ideas with institutions in the private and public tertiary sector and local administrations
- Design a sustainable system to support investments in the rational use of energy

Thermal legislation for new buildings. The Réglementation Thermique Magrébine des Bâtiments aims to promote the High Energy Performances (HPE) label in the building sector. To foster its implementation,

[67] MED-ENEC was started in 2004, as a follow-up to the Conference of Energy Ministers of the Mediterranean Basin. This project, which aims to encourage energy efficiency and the use of solar energy in the construction sector, has a budget of €4 million. Following a call for tenders in 2005, the implementation of the project was given to a consortium led by GTZ. Activities started in 2006.

the ANME has initiated 36 operations in the residential sector and 10 operations in the tertiary sector, and is promoting the HPE label. These actions aim at savings of 22 ktoe a year, resulting in cumulated savings of 60 ktoe over the period 2005–11.

Renovation of existing buildings. The Action Plan calls for a program to renovate roofs, glass work, and walls, and to weather-strip roofs. The goal is to achieve energy savings amounting to 12 ktoe by 2011, resulting in 48 ktoe of cumulated energy savings over 2005–11.

Source: Missaoui 2006.

Transport: A Unique Energy Efficiency Challenge

This section poses three questions: Why is transportation in MENA so energy intensive? What are the opportunities for efficiency gains? What are the policy options?

The transport sector is one of the main energy-consuming sectors in MENA, accounting for about 31 percent of energy consumption (2005)—somewhat higher than the average worldwide transport energy consumption of about 28 percent. Per capita transport energy consumption is higher in MENA than in any non-OECD region except for the former USSR (figure 8.4). Indexed to the world average (100), MENA's per capita energy consumption in transport is indexed at 113. The figure for MENA countries where per capita GDP exceeds $10,000 is a startling 404. Noteworthy as well is the annual rate of growth of energy consumption in the region. At 4.5 percent for 1990–2005, it is twice that of the world average and close to that of Asia (table 8.4).

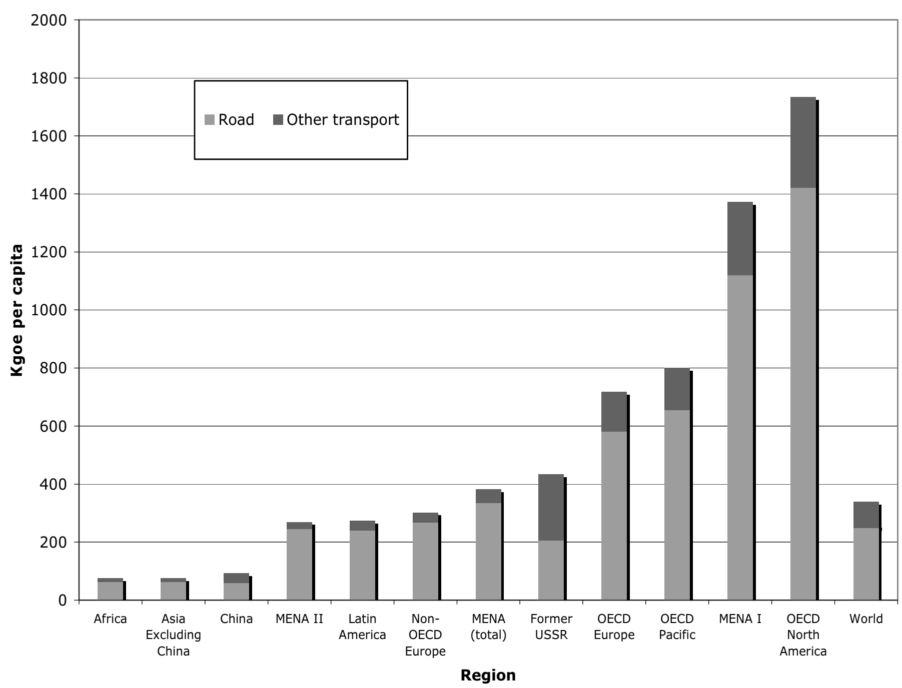
Road transport dominates transport energy consumption in MENA, at 88 percent of total sectoral energy consumption, compared to the worldwide average of 73 percent.

Table 8.4 Transport energy consumption in different world regions in 2005

	Energy consumption from transport in 2005 (MToe)	Energy consumption from transport in 2005 as % of total energy consumption	Energy consumption from road subsector in 2005 as % of transport energy consumption	Average annual growth rate in energy consumption from transport, 1990–2005 (in %)
World	**2,182.9**	**28**	**73**	**2.1**
OECD North America	752.8	39	82	1.4
OECD Pacific	160.7	27	82	2.0
OECD Europe	385.3	28	81	1.1
Africa	67.2	15	84	7.8
Latin America	122.5	31	87	2.7
Middle East	106.5	32	89	4.6
Non-OECD Europe	16.4	24	88	-2.2
Former USSR	123.4	20	47	-3.2
Asia excluding China	156.4	17	82	5.6
China	120.9	11	64	5.8
MENA	**127.6**	**31**	**88**	**4.5**
MENA > $10,000 GDP/cap	**47.1**	**33**	**82**	**4.5**
MENA < $10,000 GDP/cap	**80.5**	**30**	**91**	**4.5**

Source: World Bank calculations based on data from IEA database.

Figure 8.4 Per capita transport energy consumption by world region

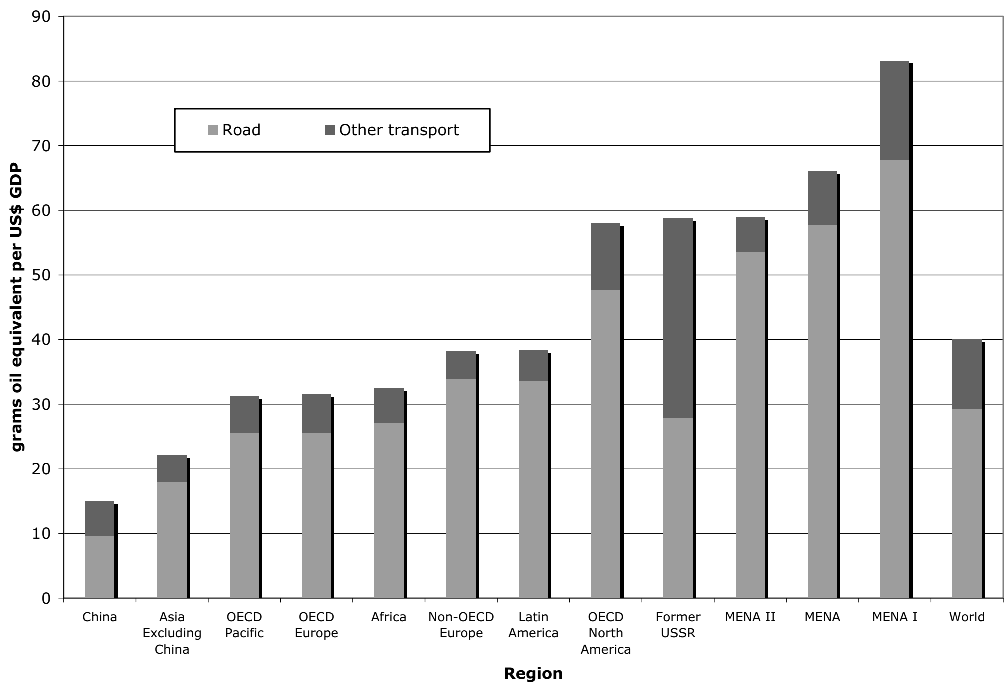


Source: IEA database

Note: MENA I = MENA countries with GDP / capita > $10,000 in 2000 dollars. MENA II = MENA countries with GDP / capita < $10,000 in 2000 dollars.

In terms of transport energy consumption per unit of GDP, MENA is the most intensive region in the world, consuming an equivalent of about 66 grams of oil for each dollar of GDP generated (figure 8.5). Indexed to world averages (100), MENA scores 165, while MENA countries whose per capita GDP exceeds $10,000 score 208.

Figure 8.5 Transport energy consumption as share of GDP by world region, 2005

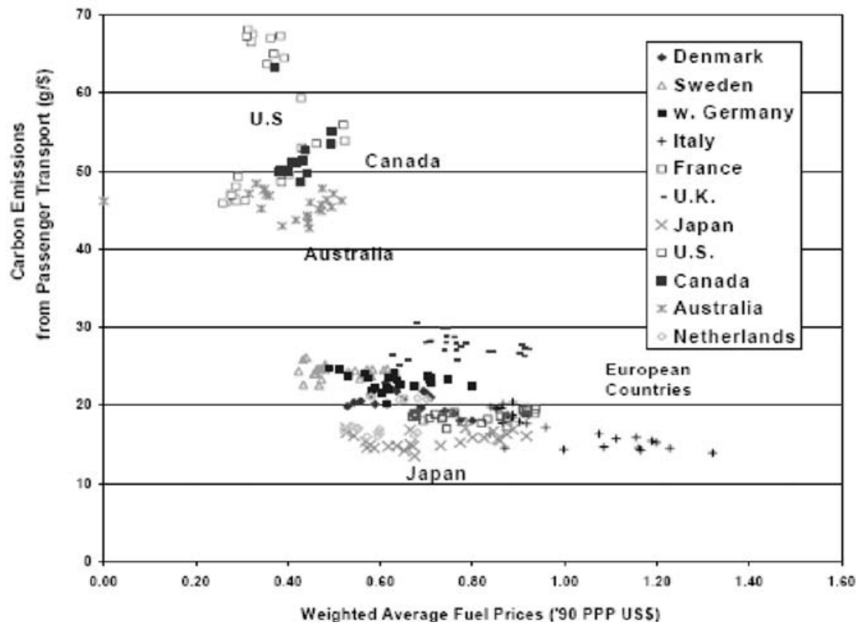


Source: IEA database
Note: GDP for 2005 expressed in 2000 dollars.

GDP Growth and Pricing Policies Affect Transport Energy Intensity

Policy and wealth together explain MENA's high energy consumption for transport. Clearly, there is a strong correlation between per capita GDP and per capita transport energy consumption (the worldwide correlation coefficient is 0.80). Figure 8.6 shows the strong inverse relationship between fuel prices (*x* axis) and the fuel intensity of vehicles. The high level of fuel subsidies in MENA (as explained in chapter 4) appears to encourage transport fuel intensity in the region's economies.

Figure 8.6 Correlation between fuel prices and transport fuel intensity is negative



Source: Schipper 2005

Fuel prices also affect the overall volume of transport demanded, and, over time, can influence settlement and land-use patterns, as prevailing prices become capitalized into land values.

Opportunities for Energy Efficiency Gains in Transport

From a technical perspective, the energy consumed by a country's transport sector is a function of the amount and nature of the demand for vehicular travel and the energy intensity of the vehicles used to meet that demand. Factors affecting demand for vehicular transport in urban areas, interurban travel, and freight transport are described in box 8.5.

Box 8.5 Factors affecting demand for vehicular travel

In urban areas, demand for vehicular travel is a function of a complex set of interactions involving:

- The size of the metropolitan area population
- Mobility rates—that is, the number of trips per day each person makes (which, in turn, is influenced by many factors, including the type of vehicles to which people have access)
- The amount of time people are willing to spend each day traveling
- The speeds on transport networks at the time people want to travel
- The proportion of desired trips that are too far to walk
- The costs associated with vehicle movement and storage
- The viability of public transport and non-motorized modes as an option for a given trip
- Various incentives and disincentives, such as congestion charges

Compared to urban travel, particularly in urbanizing economies, nonurban and interurban passenger travel tends to be a relatively minor source of growth of overall energy consumption from a country's transport sector. The absence of statistics in MENA makes estimating the contribution of this subsector difficult.

The demand for vehicular travel from the freight sector tends to be dependent on a number of factors, including:

- Underlying demand for goods in various industries
- Value-added content of various production inputs
- Structure of manufacturing processes
- Costs and availability of land for warehousing inputs
- Location of transformation sites relative to upstream transformation sites, raw materials extraction sites, ports, and downstream markets
- The relative and absolute costs of transport services provided by different companies and different modes (which are, in turn, influenced by the quality and quantity of infrastructure available for the different modes)

A second determinant of transport energy intensity is the energy efficiency of the vehicles used to meet the demand. The energy intensity of the vehicle fleet is largely determined by four factors, each of which can be influenced by public policy:

- The energy efficiency of newly acquired vehicles entering the fleet
- The maintenance practices employed to minimize energy intensity over a vehicle's lifetime
- Which vehicles tend to be used for which purposes, how intensively, and for how long
- The nature of traffic conditions on the roadways where vehicles are most often used.

Unfortunately, national data upon vehicle use and traffic flows in MENA are not easily available. It is not therefore possible to explore the details of the transport energy intensity of the region's economies.

Options to Reduce Energy Intensity in Transport

Bringing down energy intensity requires both direct and indirect measures.

Direct measures include fuel price increases; measures to restrain growth in demand for private vehicle use, particularly in cities (for example, incentives to change trip patterns, to take public transportation, disincentives to use private cars); investment in public transport based on a vision for public transport services well articulated within urban planning, as in Amman (box 8.6); steps to bring people and jobs closer together, thereby reducing the need for long-distance transport; more systematic measures to improve the fuel economy of vehicles (standards or taxes and fees to encourage use of economical cars); and fee regimes for private vehicles that are designed to encourage registration.

Indirect, or structural, measures might include the following:

- A commitment to track transport activity and publish annual figures on passenger kilometers, freight ton-kilometers, passenger trips, freight tons hauled, and so on. This would enable policymakers to identify the specific causes of high transport energy use and thus adopt strategies to manage it.

- Greater emphasis on strategic, rather than project-based, analysis (integrated transport and urban planning, alternative analysis, strategic environmental and social assessments), provided institutional barriers can be overcome to allow cooperation among sector planning agencies. This will enable policymakers to integrate transport energy use concerns into urban and land-use planning.

Box 8.6 A vision for public transport and city growth in Amman, Jordan

Amman's approach to public transport investment in its Metropolitan Growth and Vision plan calls for a hierarchy of public transport. The top tier, for the moment, is identified in planning documents simply as "high-order transit lines." The plan identifies locations and corridors where this "high-order transit" service would be most appropriate, in parallel with other aspects of city development. Several possible modes are mentioned, including underground metro (almost certainly inappropriate at the levels of demand specified), traditional light rail transit, "advanced" light rail transit, and bus rapid transit SEE. However, specific modes are not chosen at this stage. Similarly, the plan identifies the rough order-of-magnitude level of demand to be accommodated and lays out detailed land-use planning guidelines needed to generate this demand.

Source: Greater Amman Municipality 2008.

Irrigated Agriculture: Where Energy Efficiency Meets Food Prices and Rural Livelihoods

What is the energy intensity of irrigated agriculture? What is the cost of irrigated agriculture? What are the opportunities for energy-efficiency improvements? What environmental benefits would be generated from energy-efficiency gains?

Irrigated agriculture represents 45.7 percent of MENA's cultivated areas (World Bank 2007a). The total irrigated area in the region is now about the same as that in the United States. Iran alone has the world's fifth-largest expanse of irrigated land. This irrigated area has huge implications for energy consumption and for water-resource management (1,000 hectares of gravity irrigation consumes, on peak days, the same amount of water as would a city of 1 million people) (Ibid.).

In the 13 countries for which data are available (figure 8.7), agriculture contributes 12 percent of GDP, ranging from 27 percent for Syria to 2.4 percent for Oman. Agriculture accounts for less than 10 percent of GDP in Iraq, Jordan, Lebanon, Oman, and Saudi Arabia. Agriculture accounts for between 10 and 20 percent of GDP in Algeria, Egypt, Morocco, and Tunisia. Agriculture is more than a fifth of GDP only in Syria.

Across countries, irrigated agriculture brings a wide range of value-added per cubic meter of water (Table 8.6), suggesting (a) a wide range of cropping patterns (between commercial export crops and food crops for the domestic market); and (b) a wide range of production costs, including water and energy costs.

Table 8. 6 Yearly Unit Value Added per Water and Energy Use

Country	Value Added per Cubic Meter of Water Use ($/m^3)	Water Withdrawal per Hector of Irrigated Land (m^3/ha)	Energy Use in Irrigation per Hector of Irrigated Land, (kWh/ha)
Algeria	1.17	8,691	2,356
Egypt	0.29	15,736	2,674
Iran	0.16	10,744	1,537
Iraq	0.04	11,299	332
Jordan	0.22	9,881	3,527
Lebanon	1.16	7,856	1,961
Libya	n.a.	11,215	8,959
Morocco	0.43	7,928	546
Oman	0.32	16,935	7,018
Saudi Arabia	0.43	12,567	10,239
Syria	0.25	14,789	3,471
Tunisia	1.08	6,076	3,065
Yemen	0.15	12,888	10,456
West Bank and Gaza	n.a.	8,866	2,215

Source: World Bank staff estimates and calculations based on data from World Bank GDI and FAO AquaStat databases

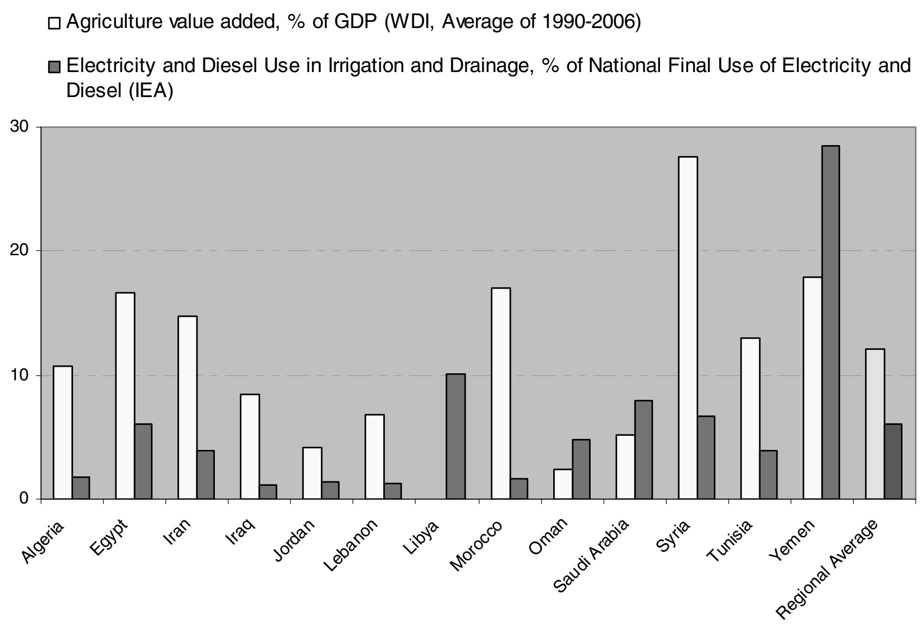
Irrigation Pumps Consume Relatively High Amounts of Energy

On average for the region[68], pumping of water for irrigation and drainage consumes 6 percent of total final use of electricity and diesel, more or less equivalent, for electricity, to 57 terawatt-hours (TWh) (figure 8.7). Again, the spread across countries is significant—from 1.1 percent in Iraq to 28.5 percent in Yemen—reflecting the range of water resources, irrigation technologies, and land available for cropping. The countries of the region fall into three groups. Those in which irrigation pumping consumes less than 5 percent of electricity and diesel are Algeria, Iran, Iraq, Jordan, Lebanon, Morocco, Oman, and Tunisia. This activity consumes between 5 and 10 percent of electricity and diesel in Egypt, Syria, Saudi Arabia and Libya. It consumes more than 20 percent in Yemen.

Yemen, Saudi Arabia, and Libya rely on groundwater that must be pumped from deep below. Egypt's irrigation and drainage system is energy intensive because of flood control dikes that require water lifting. In absolute terms, Saudi Arabia's agriculture is the largest energy consumer (17,700 gigawatt-hours, GWh) (figure 8.8). The country relies almost entirely on sprinkler irrigation. Iran is the region's second-largest energy consumer for irrigation and drainage purposes (12,300 GWh). About half of its irrigated land (8.1 million hectares, ha) uses groundwater for irrigation. Most of the countries fall below 4,000 kWh/ha per year; only four—Libya, Oman, Saudi Arabia, and Yemen—consume between 7,000 and 11,000 kWh/ha/year (figure 8.9), again reflecting the source of water, irrigation technologies, and cropping patterns.

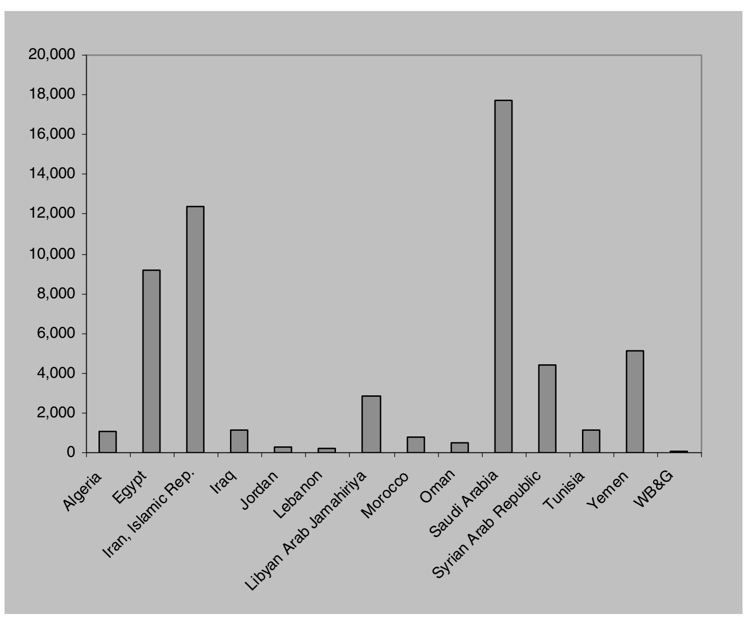
[68] Represented by the 13 countries which are modeled.

Figure 8.7 Agriculture's contribution to GDP and electricity and diesel use for irrigation and drainage vary across MENA countries [69]



Source: World Bank staff estimates and calculations based on data from WDI and IEA databases

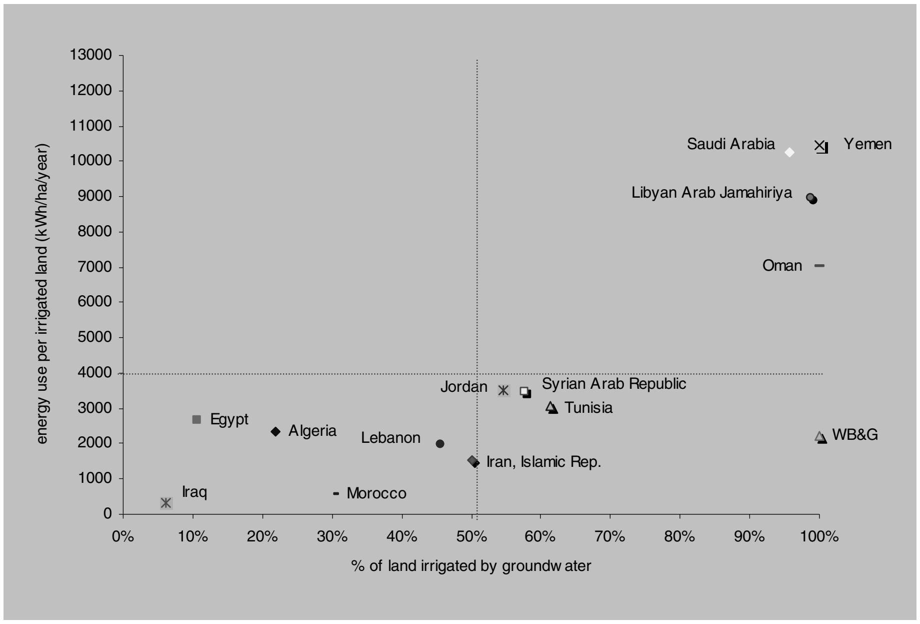
Figure 8.8 Irrigated agriculture: Energy consumption in GWh equivalent in 14 MENA countries



Source: FAO AquaStat database

[69] For West Bank and Gaza, available is neither total final use of electricity and diesel nor agriculture value added.

Figure 8.9 Energy consumption (kWh/ha per year) and share of groundwater irrigation in 14 MENA countries



Source: FAO AquaStat database

A Broad Spectrum of Costs in Irrigation and Drainage

The total economic cost of energy – including subsidies - for irrigation and drainage in the region is estimated at \$4.3 billion—about 9 percent of agriculture value-added on average. In Yemen, the economic cost of irrigation and drainage is more than 30 percent of total value-added in the agriculture sector. In Saudi Arabia, Jordan, Oman, Syria, Iran, and Iraq, it is 15 percent, 12 percent, 10 percent, 8 percent, 7 percent, and 7 percent, respectively.

If the energy cost of irrigation and drainage is estimated in terms of (subsidized) prices, it is significantly less: 2 percent of agriculture value-added. Table 8.7 compares the cost of irrigation and drainage energy per hectare in economic and financial terms. The economic cost was calculated using economic prices for electricity and diesel (table 8.6) while the cost in financial terms is calculated using the often-subsidized domestic energy prices.[70]

Table 8.7 Comparison of domestic and economic fuel prices (\$/kWh)

	Average domestic price in MENA countries (including tax)	Economic cost
Diesel	0.021	0.066
Electricity	0.054	0.082

Source: Price reference used for Chapter 4, IEA 2007a and Bloomberg

Providing the right energy price signals to farmers is critical for the efficiency of irrigation and drainage. For example, in Yemen, farmers pay about 20 percent (\$147 per hectare) of the economic costs

[70] An update of these figures will be done when the final economic prices become available from the final version of chapter 4. In this table, the economic prices are, for electricity, the OECD Europe average for households, and for diesel, the average price at pumps in EU25, net of taxes.

($700) of the energy they use. The implications of this high rate of subsidy are: (a) a propensity to irrigate more than needed, leading to depletion of the water table, greater salinity, and overconsumption of energy; (b) a suboptimal choice of crops (c) a fiscal cost of subsidies that becomes unsustainable (as discussed in chapter 2); and (d) a situation in which pricing reform becomes politically difficult (see chapter 5).

Table 8.8 Economic and financial cost of energy use in irrigation and drainage in 13 MENA countries ($/ha/year)

	In economic terms	In financial terms
Algeria	158	65
Egypt	205	53
Iran, Islamic Rep.	111	10
Iraq	26	3
Jordan	311	146
Lebanon	195	141
Libyan Arab Jamahiriya	474	252
Morocco	42	50
Oman	612	339
Saudi Arabia	891	144
Syrian Arab Republic	268	72
Tunisia	223	131
Yemen	706	147
West Bank and Gaza	174	231

Source: Staff estimates based on data from FAO AquaStat and price reference used for Chapter 4.

Opportunities for Improving Energy Efficiency in Irrigated Agriculture

In the current context, many opportunities exist to improve MENA's energy efficiency profile in irrigated agriculture, ranging from switching from diesel to electricity where feasible, improving pumping efficiency (either through redesign or equipment renewal), and using more appropriate irrigation technologies. In an attempt to quantify the potential energy efficiency gains, we modeled three types of improvement for 14 countries (table 8.8 and figures 8.10–11).

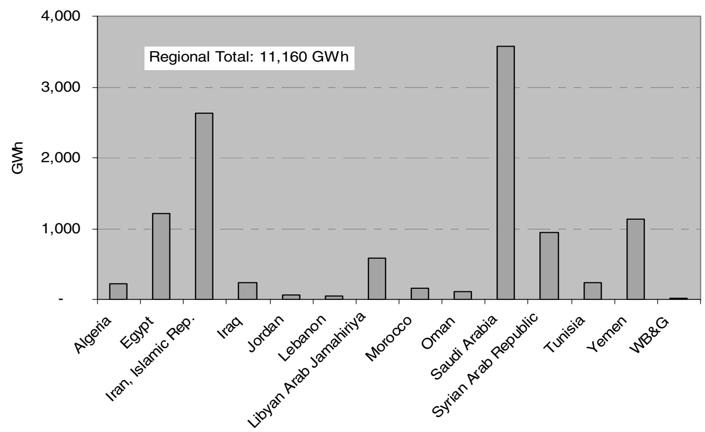
Table 8.8 Potential energy-efficiency gains in irrigated agriculture in 14 MENA countries

	Benefits for region	
Source of savings	$ millions	Energy saved
10% of fuel use switched from diesel to electricity	62	3.0% of energy consumption (but only 1.4% of cost, as electricity is more expensive than diesel)
10% improvement in pump efficiency	850	11,160 Gwh, or 13–22% of energy costs, depending on the countries
5% of irrigated land converted from flood/surface irrigation to drip irrigation	600	No energy savings

Source: World Bank staff calculations.

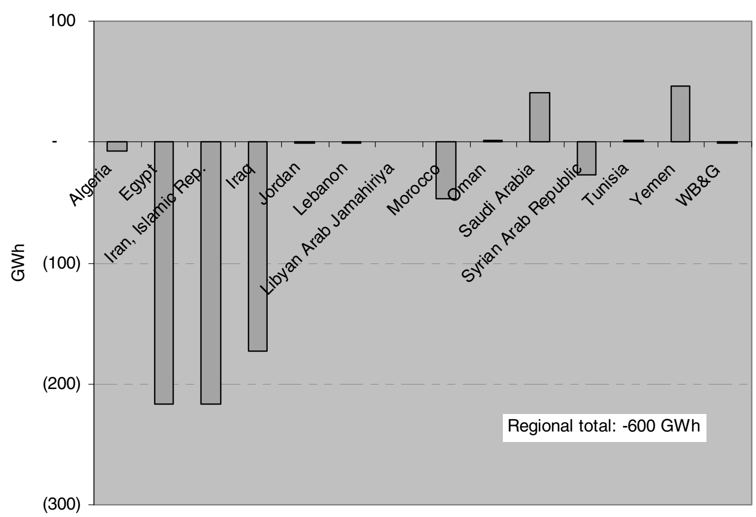
The options for energy saving do not necessarily entail water savings, and vice versa. Our model shows that when 5 percent of land currently irrigated using surface irrigation is converted to drip irrigation, energy use increases by 1 percent for the total of the 14 countries. Water is saved, however, because it is applied more efficiently to crops. The adverse energy effect varies by countries owing to different water supply sources and uses. In Iraq, for example, energy use in irrigation and drainage would increase by 15 percent, because Iraq relies heavily on surface water, which minimizes the energy-saving effect of water savings. Yemen, however, gains 1 percent in energy savings by practicing the 5 percent switch in irrigation technologies, as it depends completely on deep groundwater.

Figure 8.10 Energy savings from 10 percent incremental improvement in pump efficiency



Source: World Bank staff calculations.

Figure 8.11 Energy savings from conversion to drip irrigation on 5 percent of irrigated surface area



Source: World Bank staff calculations.

Energy efficiency policies need to be tuned to the different situations of men and women.

Whatever the sector, understanding the different roles of men and women is important for designing effective energy efficiency policies. The World Bank undertook studies on women and energy efficiency in Egypt and Tunisia to explore this issue.

The higher the level of education, the more informed men and women are on energy issues, on the merits of certain appliances (e.g., CFLs versus incandescent lights) and on energy conservation. In Egypt, the high level of illiteracy in poor urban neighborhoods and in rural areas is seen as a major obstacle to informing women about energy. Energy efficiency programs have lacked continuity, and women complained of the poor quality of new energy efficient appliances such as CFLs.

In Tunisia, the poor perceive the government's energy efficiency policies as discriminating in favor of upper income groups (LPG subsidies, solar systems), or benefiting large enterprises to the detriment of small enterprises. Government energy efficiency programs have not been particularly gender sensitive, neither to understand the specific energy needs of women and men, nor to inform each group on how to become more efficient energy users, with the exception of wood and charcoal production and use; as women in the rural areas are often the suppliers of wood energy, some programs have targeted women in order to reach environmental protection objectives, namely to fight deforestation. Government programs supported by international development assistance or NGOs have not been gender-sensitive either. The National Association of Women Entrepreneurs has recently started focusing on energy issues, and could be a effective vector of information to induce behavior change on efficient energy consumption in enterprises.

The findings of the studies lead to three important conclusions:

- Targeting both women and men, equally but distinctly, in energy efficiency programs (consultations, information etc.) could improve the performance on energy efficiency, both at the household and enterprise levels; at the same time, energy efficiency activities could be an opportunity to capitalize on women's current knowledge and leadership potential;
- Gender sensitivity is essential when designing pricing policies and reforms cum social protection, in particular when identifying target groups; women, in particular widows and heads of households, find themselves amongst the most vulnerable groups affected by price reform, in particular the reduction of fuel subsidies; and,
- Reaching out to consumers to influence their behaviors on energy consumption requires cooperation with a whole range of institutions, with local governments, community, and professional organizations. Different institutions will be effective in reaching out to men and women.

Conclusion

This chapter has examined four sectors that consume substantial amounts of energy: manufacturing, construction, transport, and irrigation and drainage. In each case, we found opportunities for technical improvements in energy efficiency, often with very favorable economic returns and payback periods (table 8.9).

Table 8.9 Opportunities for energy efficiency improvements in consumption sectors

Sector	Opportunities to improve energy efficiency
Industry	Industrial processes, cogeneration, waste heat recovery, preheating, efficient drives.
Buildings and municipal services	Building design and measures such as better insulation, advanced windows, energy efficient lighting, space conditioning, water heating, and refrigeration technologies. District heating systems, combined heat and power, efficient street lighting, efficient water supply, pumping, and sewage removal systems.
Transport	Efficient vehicles, urban mass transport systems, modal shifts to inter- and intracity rail and water transport, compressed natural gas (CNG) vehicles, traffic demand management.
Agriculture	Efficient irrigation pumping and efficient water use, such as drip irrigation.

Regulations, institutions, planning arrangements, and energy pricing can combine at the micro-level to create conditions in which households, firms, and farmers are likely to adopt these improved technologies, and thus realize the potential for energy efficiency gains.

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Chapter 9: Entry Points and Sequencing

MENA can envision an energy-efficient future. This report has shown that energy efficiency can help MENA achieve its development goals in terms of growth, welfare, and social development. Energy efficiency can improve energy security for countries, enterprises and households. Energy efficiency is good business, with high returns on investments. Other gains include reduced air pollution. The report has given concrete examples of countries that have overcome the political obstacles to policy reform with social protection measures. The report has also highlighted that good communications between policy makers and the public and a solid package of incentives to balance reforms and social protection are at the heart of behavioral changes.

The starting point – high energy intensity, subsidized prices, and fiscal pressures – offers major opportunities to move forward. Some countries are ahead of others in terms of energy efficiency, but all have opportunities to advance.

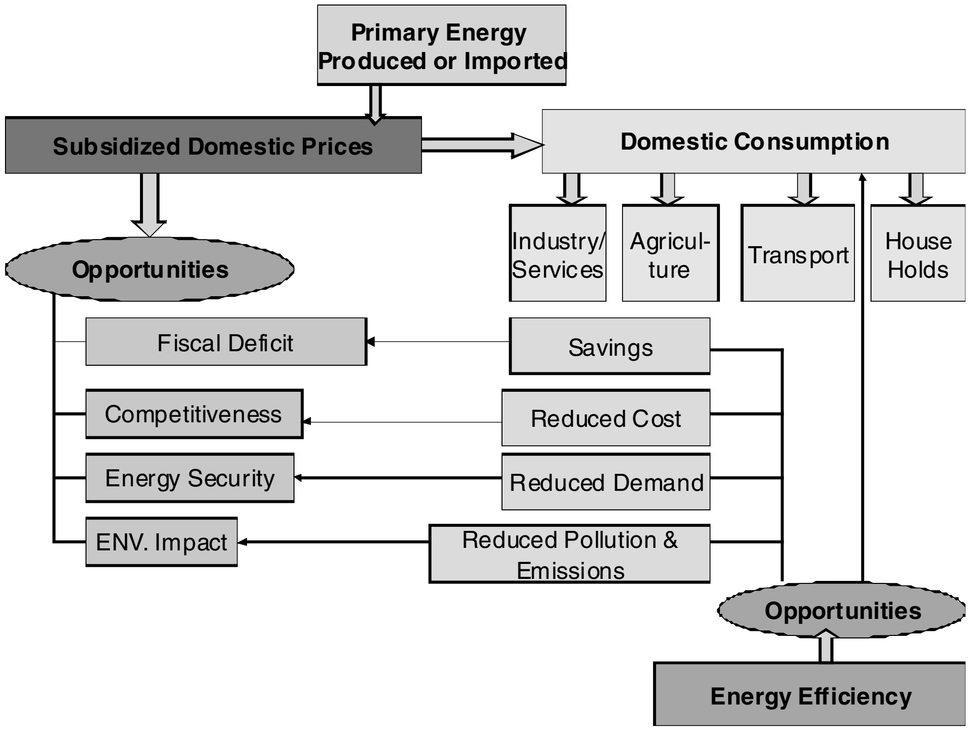
How can the Region become a world leader on energy efficiency? This is the aspiration expressed by several MENA countries. This chapter offers three main suggestions, addressed in three separate sections:

- Finding the appropriate entry points to develop a sustainable energy efficiency market
- Mobilizing all stakeholders, and
- Accounting for results.

Finding Appropriate Entry Points

The causality between prices, energy consumption and energy efficiency is well established (Figure 9.1). The implementation challenge is to find entry points for energy efficiency: harvesting lost energy (e.g. gas flared, or electricity and gas lost in transport), pricing and subsidy reform, environmental remediation, or focusing on specific high consuming sectors, services, and products. Each country is different, and will choose its own path, based on its wealth, resource base, socio-economic conditions, and political economy.

Figure 9.1. Energy efficiency, prices and consumption are linked to national development objectives



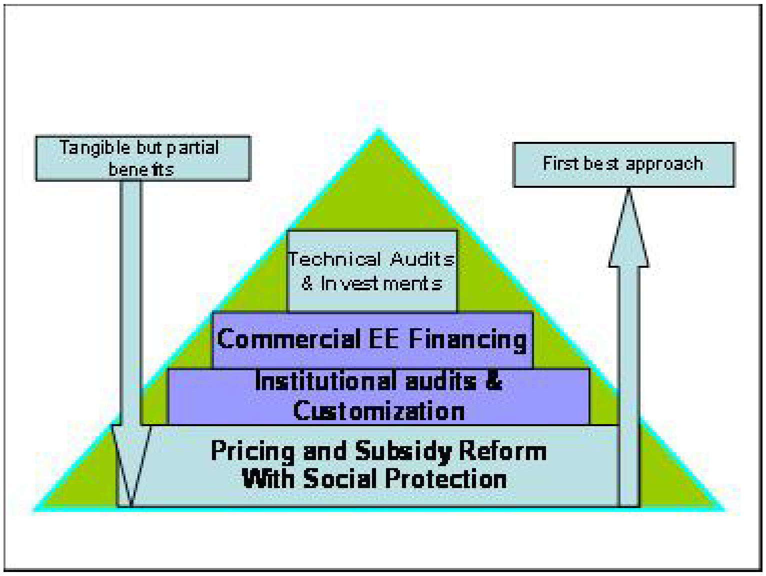
The sequencing choice: "first best" vs. "better than nothing"

Does the *sequencing* of interventions matter? There are no easy answers to this question; these are embedded in the political economy of the region and of individual countries. But international experience underlines that countries that have obtained significant results on energy efficiency successfully did so by aligning economic incentives, institutions, financing, and technical options.

Pricing reform-with-social protection is the most difficult but also the highest priority intervention. Energy pricing establishes the foundations for the efficient production and use of energy. As seen from regional and international experience, efforts undertaken on energy efficiency – be they technical or institutional – have yielded incomplete results until prices provided energy producers and consumers the right economic signals. Depending on the country, options in pricing reforms involve adjusting price levels, rate structures, and tariff flexibility, or a combination of these elements. Mindful of the socio-political context, complementary social protection interventions facilitate implementation.

However, implementation of pricing reform is complex and politically difficult, and preparation of the reform can take time. Meanwhile, other institutional and regulatory interventions as well as technical improvements can start, and yield partial but positive results. The conceptual pyramid presented in the overview can therefore be restated as a choice between a first-best approach and a lower-risk, lower-return approach. (Figure 9.2). This recognizes that first best solutions are not always feasible.

Figure 9.2. Approaches to energy efficiency: the better and the best



So developing the institutional framework for energy efficiency follows pricing as a priority. Given the quick paybacks and economic returns, lack of capital is rarely the true barrier to energy efficiency investments; inadequate organizational and institutional systems for developing projects and accessing funds are actually the main problem. Therefore, mechanisms to capture opportunities for energy efficiency investment need to be created or strengthened. This entails sustained efforts over years—new institutional constructs cannot be expected to develop and grow overnight.

Institutional framework, and zooming in on programmatic arrangements. Chapter 6 identified two pillars of an institutional framework for energy efficiency: enabling frameworks and implementation arrangements. Enabling frameworks include laws and decrees on energy efficiency, national energy strategies and plans, apex agencies for the energy sector, and regulatory regimes. Implementation arrangements consist of specialized agencies, programmatic arrangements, and the mobilization of a broad range of stakeholders.

Once the broader institutional and incentive environment has been thought through, it is time to focus on supporting tangible change in firms and households: programmatic arrangements.

Programmatic arrangements need to be customized to national environments. Energy efficiency concepts must be marketed to enterprises and customers, and specific projects must be identified, designed, and appraised. This requires capacity, typically provided by national experts. Human and organizational capacity is needed to define target markets and market outreach strategies, identify project opportunities, design appropriate project packages at end-user facilities, assess financial returns and risks, and understand each party's incentives to participate.

Early assessment of potential markets is important. Selection of market segments for concentration will define organizational arrangements for technical work and the types of financial products developed. Once target markets are defined, market outreach and marketing of project or program concepts needs to be conducted, followed by preparatory work. Project/program development includes a series of key tasks including technical assessments, initial identification and screening, customer enlistment/acceptance of proposed project concepts, detailed design of components, economic analysis, and identification and allocation of risks.

The capacity to undertake preparatory work is typically found within project consultancy companies, energy survey and auditing firms, university or research institute departments, industry associations, equipment vendors, or ESCOs. In some countries (such as Egypt and Tunisia), existing local capacity in the energy efficiency industry is strong. In countries where local capacity is weak, development of this capacity then becomes a top priority—even a prerequisite—for energy efficiency project development. At times, capacity might be borrowed from neighboring countries, but experience has shown that excessive reliance on international consultants is generally unsustainable.

When it comes to financing, the golden rule is to subsidize access, not to offer concessional terms for end-users. Financing and technical assessment services to end users should be provided on commercial terms, as the financial viability of energy efficiency investments should be strong, and commercial terms provide the only foundation for sustainability in the market. The financial returns of energy efficiency projects and programs are typically high; where they are not, issues of energy pricing or the project identification and prioritization mechanisms need to be addressed. Reliance on end-user subsidies to sweeten the market introduces the issue of sustainability. Often, end-user subsidies underpin programs, but subsidies prove difficult to maintain over the long term as the total market size exceeds the amount of subsidy available, and programs collapse when the subsidies end. In addition, market distortions caused by subsidies can easily inhibit growth of commercially sustainable energy efficiency solutions in the market—making the subsidized program actually counterproductive for achievement of the goal of sustainable energy efficiency investment.

By contrast, provision of concessional financing to buy down the costs of starting up new institutional mechanisms is another matter. It is often a good use of public funds to support intermediaries in the development of new project delivery mechanisms. Options for this include provision of concessional finance to subsidize initially high transaction costs during development phases, to buy down risks involved in program startup, to develop and pilot new approaches and products, and to develop the wide range of capacities needed for program implementation. One example is to initially provide grants or contingent grants for energy audits that new ESCOs are frequently unable to bear up front (World Bank/GEF 2004). However, these are transitional measures to help put new, commercially sustainable mechanisms in place.

Technical interventions, although not the first priority, can help kick-start energy efficiency improvements. From a socio-political perspective, technical interventions are benign. They bring visibility to energy efficiency and can yield quick and tangible results.

Lighting for example, consumes 19% of global electricity production, an amount which exceeds the total quantity of electricity consumed in OECD countries, for all purposes (IEA

2006). Targeting an energy service like lighting makes sense in any economy as it touches all consumer groups: public and private, industry, commercial and municipal services and households. All countries in the Region are likely to see an increase in their demand for lighting given the projected growth per capita. This is a chance for all countries to universally adopt efficient lighting and, in that market segment, easily achieve a 20% reduction in energy consumption.[71]

Energy audits are often a practical entry point for technical interventions. They can be performed at the sector, enterprise or household level. An energy audit identifies and evaluates energy management opportunities at a defined site. It focuses on specific areas of the site's energy system, such as natural gas boilers, steam distribution, motor systems, refrigeration, compressed air, venting systems and related water and wastewater discharge issues. During an audit, a baseline is developed to characterize and benchmark energy use. Individual unit operations, processes and major energy-consuming equipment are evaluated to identify efficiency opportunities and high return-on-investment projects. An action-oriented report describes each opportunity area, including an estimate of the cost to implement the changes, the savings that will be generated, and the payback period. The goal is to ensure that companies have access to affordable, customized audits, so that they can make sound business decisions about how to become more energy efficient and reduce GHG emissions at their facilities (Shah 2008).

Cogeneration and heat recovery in power and manufacturing is another example of entry point relevant for most countries in the Region.

Cutting energy losses in the power system can result in enormous revenue gains that could be expended in other sectors of the economy. Efficiency improvements across the generation, transmission, distribution and end-use chain are relatively cheaper than adding new capacities, and can be effected through a wide range of technical, institutional, economic and financial of instruments. Technical interventions can include:

- High efficiency technologies for re-powering existing capacities in the area of generation, transmission and distribution (T&D);
- Combined cycle, supercritical boilers, IGCC technologies, etc., that have significantly higher efficiencies than the average existing fossil-fuel power plants (in the range of 30% in developing countries);
- Improved maintenance (higher availability and plant load factors) of existing stock of generation plants;
- Reduction of technical losses in transmission and distribution (15% or more in developing countries) to the OECD average levels of 6-7% through introduction of high voltage transmission systems, better insulated conductors, efficient transformers, reactive power compensation and improved metering/instrumentation.

[71] See Chapter 4, Figures 4.1a and 4.1b.

Mobilizing stakeholders at the national and international levels.

Mobilizing national and regional stakeholders.

Consultations with national stakeholders, including users, government departments, municipal governments, utilities, financial institutions, manufacturers and other private service providers, and NGOs is critical for the formulation of national energy efficiency policies and programs. Information sharing on objectives, facts, and other country experiences is a powerful tool to identify options and adapt them to the local context. Furthermore, as illustrated in chapter 7 with the cases of Brazil and Japan, it is never too early to sensitive future generations on energy efficiency through school education programs, and frequent communication campaigns over many years are needed to sustain behavioral changes.

In France, the Agency for Environment and Energy (ADEME) helps to achieve the country's Kyoto Protocol Target of reducing GHG emissions by 3 percent annually and decreasing energy intensity by 2 percent annually until 2025. One of ADEME's successes has been its work in partnership with municipalities. France's strategy relies on development of knowledge and innovation through collaboration with research institutions (positive energy buildings, efficient cars, eco technologies) and information for stakeholders (local authorities, enterprises, large public, awareness campaigns, etc.). In India, in the State of Madhya Pradesh, the utility is working on street lighting with 150 municipalities. The model which includes contracting about 12 ESCOs, is being replicated in agriculture, to improve irrigation pump efficiency. Another useful way to engage a broad section of stakeholders is through their respective associations or federations.

The experience of the 10 ASEAN[72] countries may be one of the most useful on how to foster international collaboration on energy efficiency. ASEAN is a heterogeneous mix of economies with greatly varying energy resource endowments and energy sectors. In spite of these differences, the 10 countries have common aspirations in achieving sustainable energy development, particularly on the rational use of energy. The Regional Plan of Action for Energy Cooperation 2004-2009,[73] has established energy efficiency and conservation as one of its core program with planned collaboration on: continued information sharing and networking, focusing on policy, products, technologies and best practices; expansion of the ASEAN Standards and Labeling (S&L) program; enhanced private sector involvement, including beyond the 10 countries; capacity building on audits, benchmarking, energy management systems, standardization and technology transfer, promotion of ESCO businesses, and of energy efficiency in transport. At the country level, each individual ASEAN member nation has put in place policies and programs to enhance energy efficiency improvements.

[72] The 10 countries are Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam.
[73] See http://www.aseansec.org/pdf/APAEC0409.pdf

In the context of the European Neighborhood Policy, the EU has an agreement with the Mediterranean Partner Countries (MPCs) that aims at (i) accelerating energy reform and harmonizing norms and regulations in the MPCs, (ii) fostering market integration, with a focus on electricity and gas, and (iii) extending interconnections, both at regional and sub-regional levels. In 2004, a regional EC project entitled MED-ENEC (Energy efficiency in the construction sector in the Mediterranean) was approved, with the aim of slowing down the growth of electricity consumption, particularly from air-conditioning installations, by encouraging insulation, natural ventilation, bio-climatic design, and the use of solar thermal energy. Finally, it is worth recalling MCREEE, the regional center for renewable energy and energy efficiency mentioned in Chapter 5.

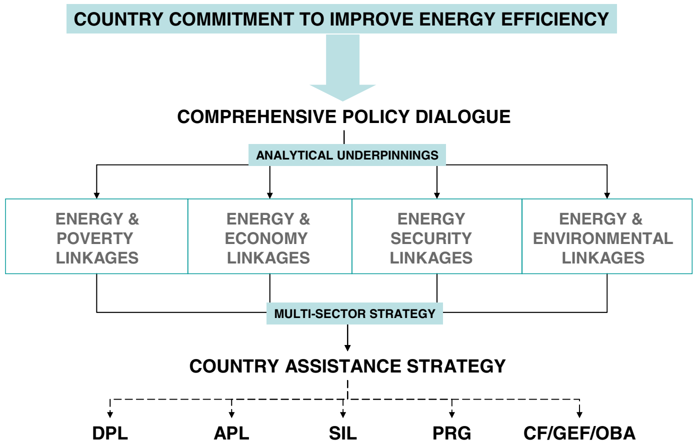
Mobilizing International Partners

MENA can take advantage of the current high level of interest in energy efficiency among international development partners.

With the World Bank Group (WBG), MENA countries have already developed a strong partnership, both through technical assistance and project financing. They have the opportunity to integrate energy efficiency in all instruments of country programs, from policy advice and technical assistance to investment financing.

-- *Integrating Energy Efficiency in Country Assistance Strategies.* The World Bank Group can support policies and programs to ensure that energy efficiency objectives and priorities are integral to country-specific strategies to: (i) support economic growth; (ii) enhance energy security; (ii) eradicate poverty; and (iv) mitigate adverse environmental impacts. Therefore, the Bank can help its partners identify and exploit opportunities to improve the efficiency of energy production, transport, distribution and use. In so doing, the WBG can offer its range of assistance instruments – analytical and advisory activities, technical assistance, investment and development policy lending, and guarantees for commercial sources of financing (Figure 9.3). The advantage of integrating energy efficiency into the country assistance strategy is the opportunity to adopt a systematic approach to identify opportunities, not only for self-standing energy-efficiency projects, but also for energy efficiency components of other projects.

Figure 9.3. Energy Efficiency within the Country Assistance Strategy



-- *Lending***:** the World Bank can respond to a range of demands that the client country might express. They could include funding for investments to reduce energy losses in the power system, the development of institutional frameworks, the implementation of financing facilities, or lending in support of energy price reforms with improved social protection. The combination of Bank, IFC and MIGA instruments is determined by which set of assistance tools is most appropriate to address the specific risks of the energy efficiency intervention and objective identified. In general, where the Government is a key actor, World Bank tools and skills are particularly useful; if an operation is set sup directly with private entities without the government or without a major policy focus, IFC's instruments may work best. In addition, the Bank can help leverage funding from other funds such as the Global Environmental Facility, Carbon Finance, and the recently set-up Climate Change Trust Fund (box 9.1).

Box 9.1 Financing Clean Technologies

In August 2008, the Board of Directors of the World Bank approved the creation of the Clean Technology Fund (CTF), amongst the two main Climate Invest Funds (CIF) to finance remediation to climate change; the other fund being the Strategic Climate Fund (SCF). The CTF will finance the deployment and transfer of low-carbon technologies with a significant potential for long-term greenhouse gas emissions savings, in particular in the power and transportation sectors, and energy efficiency in buildings, industry and agriculture. By contrast, the SCF will provide financing to pilot new development approaches or to scale-up activities aimed at a specific climate change challenge through targeted programs. For example, under the CTF, there is tremendous potential in some countries to use the concessional funds to stimulate transformation of their public transport systems so that a lot more commuters are encouraged to take new, cleaner buses to work instead of using large numbers of cars and microbuses that contribute significantly to local air pollution and the resulting public health impacts as well as global climate change. This could include financing for new, cleaner buses together with financing for urban infrastructure to provide exclusive bus lanes. As country circumstances differ, investment programs will be developed on a country-specific basis to achieve nationally defined objectives. In order to maximize impact, the CTF will work with both the private and public sectors to bring sufficient technological know-how and capital to dramatically scale-up clear technology deployment, while remaining technology neutral. The CTF will complement the GEF and link with the capacity building programs of UNEP and UNDP. It will provide grand elements tailored to cover identifiable additional costs necessary to make projects viable. It will utilize a range of concessional financing instruments such as grants and concessional loans as well as risk mitigation instruments, such as guarantees and equity.

Source: www. worldbank.org/environment and worldbank.org/cif

-- *Engaging Policy Dialogue on Energy Efficiency*: the WBG can focus its advisory work on supporting countries' clear commitment to energy efficiency. In several MENA countries, the Bank can continue providing assistance with pricing policy and social protection reforms. It can also collaborate with technical work undertaken by the country or third parties, on both energy production and supply sectors (e.g., power, district heating) and energy consuming sectors (e.g., transportation, urban and rural community services, agriculture, manufacturing, households). A number of technical assistance facilities, funded by bilateral and multilateral donors, are available for country reviews, policy dialogue, the preparation of regulatory frameworks, and for the preparation of investment projects, including the Energy Sector Management Assistance Program –ESMAP (www.esmap.org), the Global Program on Output Based Aid –GPOBA (www.gpoba.org), the Public-Private Infrastructure Advisory Facility –PPIAF (www.ppiaf.org), the Water and Sanitation Program –WSP, and the Renewable Energy and Energy Efficiency Partnership- REEEP (www.reeep.org). Funds from the Global Environmental Facility –GEF (www.GEF.org) and Carbon Finance (www.prototypecarbonfund.org) are also available for preparing investment activities.

Accounting for Results and Networking

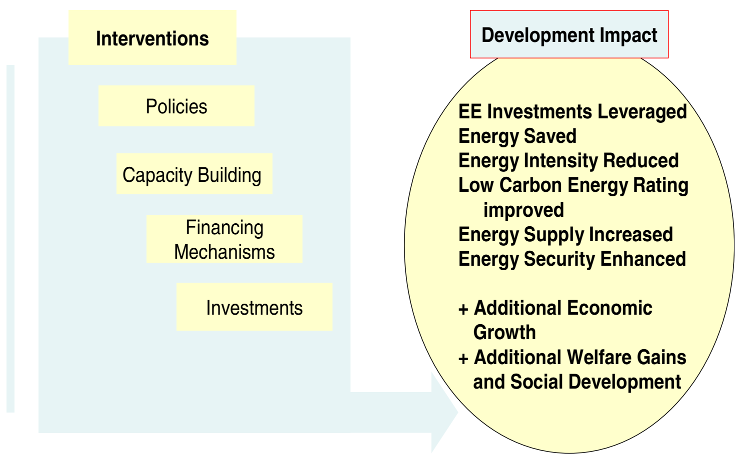
Monitoring progress on energy efficiency and publicly accounting for results is needed to maintain stakeholder engagement. A simple framework can be adopted to monitor progress and measure results and impacts of energy efficiency interventions. Four levels of accountability are pertinent:

- The Regional Level: possible indicators would include progress towards economic pricing across countries, institutional frameworks, levels of investments, and outcome on energy intensity.
- The Country Level: similar to the regional level, with more detailed development impact indicators (Figure 9.4)
- The Sector Level: to monitor the relative performance amongst sectors. The International Energy Agency (IEA) already has a significant database (i) to monitor energy efficiency macro-economic trends, and (ii) benchmark a large number of industries. The development impact indicators can be the same for each sector, as those at the country level.

- The Investment/Project Level: to ensure that project goals are achieved. Three simple and direct performance indicators are proposed: energy savings (between, with and without project), energy efficiency gains (between, with and without project), and emissions reductions (CO_2 and other pollutants).

Figure 9.4 Multi-level monitoring of energy efficiency improvements

Finally, the Bank can continue fostering networking amongst countries and institutions. The Bank's new webpage on energy efficiency (www.worldbank.org/energy efficiency) is an attempt to disseminate knowledge and information and enable sharing of experience amongst client countries. Through its convening power, the Bank can also facilitate the dissemination of good practices around the world.



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