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KOREA ENERGY MANAGEMENT CORPORATION

SAARC

# GAP ANALYSIS

## on Energy Efficiency institutional arrangements in Pakistan

*Asif Masood*

*2010*

*promoting energy efficiency towards a low carbon development path*

Green Growth

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# SAARC Energy Centre

**ESCAP Project on "Strengthening Institutional Capacity to Support Energy Efficiency in Selected Asian Countries"**

**A gap analysis assessing the barriers and challenges, faced by Pakistan to promote energy efficiency**

**Asif Masood**
**10/20/2010**

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# Abbreviations

| | |
|---|---|
| ADB | Asian Development Bank |
| ADP | Annual Development Programme |
| AEDB | Alternative Energy Development Board |
| AC | Alternative Current |
| ADF | Asian Development Fund |
| AFD | Agency Francaise de Development |
| ACGR | Annual Compound Growth Rate |
| AKRSP | Aga Khan Rural Support programme |
| APTMA | All Pakistan Textile Mills Association |
| BRESL | Barrier Removal to the Cost Effective Development and Implementation of Energy Efficiency Standards and Labeling |
| BOI | Board of Investment |
| BOO | Build, Own, and Operate |
| BOOT | Build, Own, Operate and Transfer |
| CAFÉ | Corporate Average Fuel Economy |
| CBO | Community-based Organization |
| CBR | Central Board of Revenue |
| CDM | Clean Development Mechanism |
| CER | Certified Emission Reduction |
| CNG | Compressed Natural Gas |
| CFL | Compact Fluorescent Lamp |
| CPPA | Central Power Purchase Agency |
| CRPEA | Contracts Registrar and Central Power Exchange Administrator |
| DISCO | Distribution Company |
| DMC | Developing Member Country |
| DNA | Designated National Agency |
| DSM | Demand Side Management |
| DST | Daylight Savings Time |

| | |
|---|---|
| E&P | Exploration & Production |
| EC | Energy Conservation |
| EDB | Engineering Development Board |
| EE | Energy Efficiency |
| EE& EC | Energy Efficiency & Energy Conservation |
| EEI | Energy Efficiency Initiative |
| ENERCON | National Energy Conservation Centre |
| EPA | Environmental Protection Agency |
| ESCOS | Energy Service Companies |
| EIA | Environmental Impact Assessment |
| FERTS | Fuel Efficiency in Road Transport Sector |
| FSA | Fuel Supply Agreement |
| FY | Financial Year |
| GDP | Gross Domestic Product |
| GEF | Global Environment Facility |
| GENCO | Generation Company |
| GHG | Greenhouse Gases |
| GoP | Government of Pakistan |
| GTZ | Gesellshaft fur Technische Zusammenarbeit GmbH |
| GW | Gigawatt |
| GWh | Gigawatt-hour |
| HID | High Intensity Discharge |
| HDIP | Hydrocarbon Development Institute of Pakistan |
| HPS | High Pressure Sodium |
| I&P | Irrigation and Power |
| IESCO | Islamabad Electric Supply Company Limited |
| IA | Implementation Agreement |
| IEE | Initial Environmental Examination |
| IFI | International Financial Institution |
| IPP | Independent Power Producer |
| JV | Joint Venture |
| KESC | Karachi Electric Supply Corporation |

| | |
|---|---|
| KOE | Kilogram of Oil Equivalent |
| kV | Kilovolt |
| kWh | Kilowatt-hour |
| LED | Light Emitting Diode |
| LPG | Liquefied Petroleum Gas |
| LPW | Lumens Per Watt |
| MDG | Millennium Development Goal |
| MOE | Ministry of Environment |
| MoFR | Ministry of Finance & Revenue |
| MoPNR | Ministry of Petroleum and Natural Resources |
| MoST | Ministry of Science & Technology |
| MoWP | Ministry of Water and Power |
| MTDF | Medium Term Development Framework |
| MTOE | Million Tonnes of Oil Equivalent |
| MV | Mercury Vapor |
| MW | Megawatt |
| MWh | Megawatt-hour |
| NARC | National Agriculture Research Council |
| NEAP | National Environmental Action Plan |
| NEPRA | National Electric Power Regulatory Authority |
| NESPAK | National Engineering Services of Pakistan |
| NPO | National Productivity Organization |
| NRSP | National Rural Support Programme |
| NGO | Non-governmental Organization |
| NTDC | National Transmission and Dispatch Company |
| NTRC | National Transport Research Centre |
| O&M | Operations and Maintenance |
| OGDC | Oil & Gas Development Corporation |
| OGRA | Oil & Gas Regulatory Authority |
| OMC | Oil Marketing Company |
| P&D | Planning and Development Division |
| PAEC | Pakistan Atomic Energy Commission |

| | |
|---|---|
| Pak EPA | Pakistan Environmental Protection Agency |
| PCRET | Pakistan Council for Renewable Energy Technologies |
| PIDC | Pakistan Industrial Development Corporation |
| PLF | Plant Load Factor |
| PMD | Pakistan Meteorological Department |
| PNRA | Pakistan Nuclear Regulatory Authority |
| PPEPCA | Pakistan Petroleum Exploration & Production Companies Association |
| PPA | Power Purchase Agreement |
| PPIB | Private Power and Infrastructure Board |
| PQD | Prequalification Document |
| PSDP | Public Sector Development Programme |
| PV | Photovoltaic |
| PPL | Pakistan Petroleum Limited |
| PREEE | Programme in Renewable Energy & Energy Efficiency |
| PSO | Pakistan State Oil |
| PSQCA | Pakistan Standards & Quality Control Authority |
| PWD | Public Works Department |
| R&D | Research and Development |
| RE | Renewable Energy |
| RET | Renewable Energy Technology |
| RETA | Regional Technical Assistance |
| SAARC | South Asian Association for Regional Cooperation |
| SARI | South Asian Regional Initiative |
| SECP | Securities and Exchange Commission of Pakistan |
| SHS | Solar Home System |
| SHYDO | Sarhad Hydro Development Organization |
| SMEDA | Small & Medium Enterprise Development Authority |
| SNGPL | Sui Northern Gas Pipelines Limited |
| SSGC | Sui Southern Gas Company Limited |
| T&D | Power Transmission and Distribution |
| TA | Technical Assistance |
| TDA | Trade Development Authority |

| | |
|---|---|
| ToD | Time of Day |
| TPES | Total Primary Energy Supply |
| UNDP | United Nations Development Programme |
| UNIDO | United Nations Industrial Development Organization |
| US DOE | United State Department of Energy |
| USAID | United State Agency for International Development |
| USTDA | United State Trade Development Authority |
| VAT | Value-Added Tax |
| VSD | Variable Speed Drive |
| WAPDA | Water and Power Development Authority |
| WG | Working Group |
| WTE | Waste to Energy |

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Asif Masood

# Executive Summary

Energy sector issues and development continue to severely constrain Pakistan's economy in 2009-2010. Against the backdrop of a sharp increase in the international price of oil in 2009, which put enormous upward pressure on the cost structure in the power generation and transport sector, in particular, large domestic supply shortages of electricity and gas occurred. Lower accumulation of water reserves in dams compounded the severity. The cumulative effect of the energy crisis on the economy is estimated at 2 per cent of GDP during 2009-2010 alone.

The Government of Pakistan has resolved to revitalize national action towards achieving greater energy efficiency (EE) in the country to help meet the challenges of rapid demand growth, improving economic competitiveness and ensuring equitable and affordable energy access across all consumer categories. Pakistan is seriously looking for capturing all possible opportunities for Energy Efficiency and Conservation (EE&EC) enhancement. The report is the outcome of long review and analysis supporting the inception of the Energy Efficiency Initiative and contains important findings and recommendations for implementation. The report also includes a phased roadmap for designing and implementing a National EE&EC Action Plan. This identifies a range of time bound, short, medium and long-term actions required of government, utilities, private sector, donors, and end-use stakeholders in the coming years in order to create the conducive policy and regulatory regime, strong commercial interest, effective facilitation mechanisms and appropriate consumer response necessary for lowering Pakistan's energy intensity profile and developing a viable domestic EE&EC market. The report also briefly describes on a non-exclusive basis, some immediate investment and technical assistance opportunities that could be considered by government and donor agencies for realizing readily quantified energy savings potential in different EE&EC market areas (i.e industry, transportation, households, etc.) within a short time span.

This gap analysis report on EE&EC implementation plans, initiatives and their outcomes reveals several impediments that have prevented even the most concerted and well conceived of these efforts to fail in achieving sustainable, long-term energy savings.

The study includes the evolution of EE&EC for effective implementation of policies and relies on corrective measures to promote and encourage energy consumers to save energy and make conservation economically profitable for individuals and the society. Energy Conservation Bill 2010 is expected to fundamentally pave the way for all EE&EC programmes and measures. Once the bill is promulgated, it would become easier to implement the policies and strategies across Pakistan.

A detailed Road Map has specially been incorporated in the report with a view to minimize the

gap between demand and supply which is a major policy concern and it is the basis for developing strategies to meet the challenges of EE&EC. All we need to strengthen management infrastructure in a manner to making the planning process more participatory, transparent and forward looking, increasing the capacity to monitor and implement decisions and legislation effectively and generating funds by carrying out service functions.

To conclude the report, Pakistan's current and projected energy requirements, development needs and resource shortages require immediate attention towards improving the efficiency of energy supply and use across all economic sectors, where much room for improvement exists. EE Improvement & Conservation is seldom enforced without the willingness of the end user. Hence a strong focus must be maintained on the end user at all times, especially in the case of devising measures to overcome barriers identified which would involve policy formulation, institutional development, financing schemes and other diverse activities. Some measures may be prerequisite for other measures. A classic example in this regard is the national energy policy. However, attempts in this respect have demonstrated the need for a more vigorous, systematic, and long term multi-stakeholder approach.

# 1 Introduction & Background

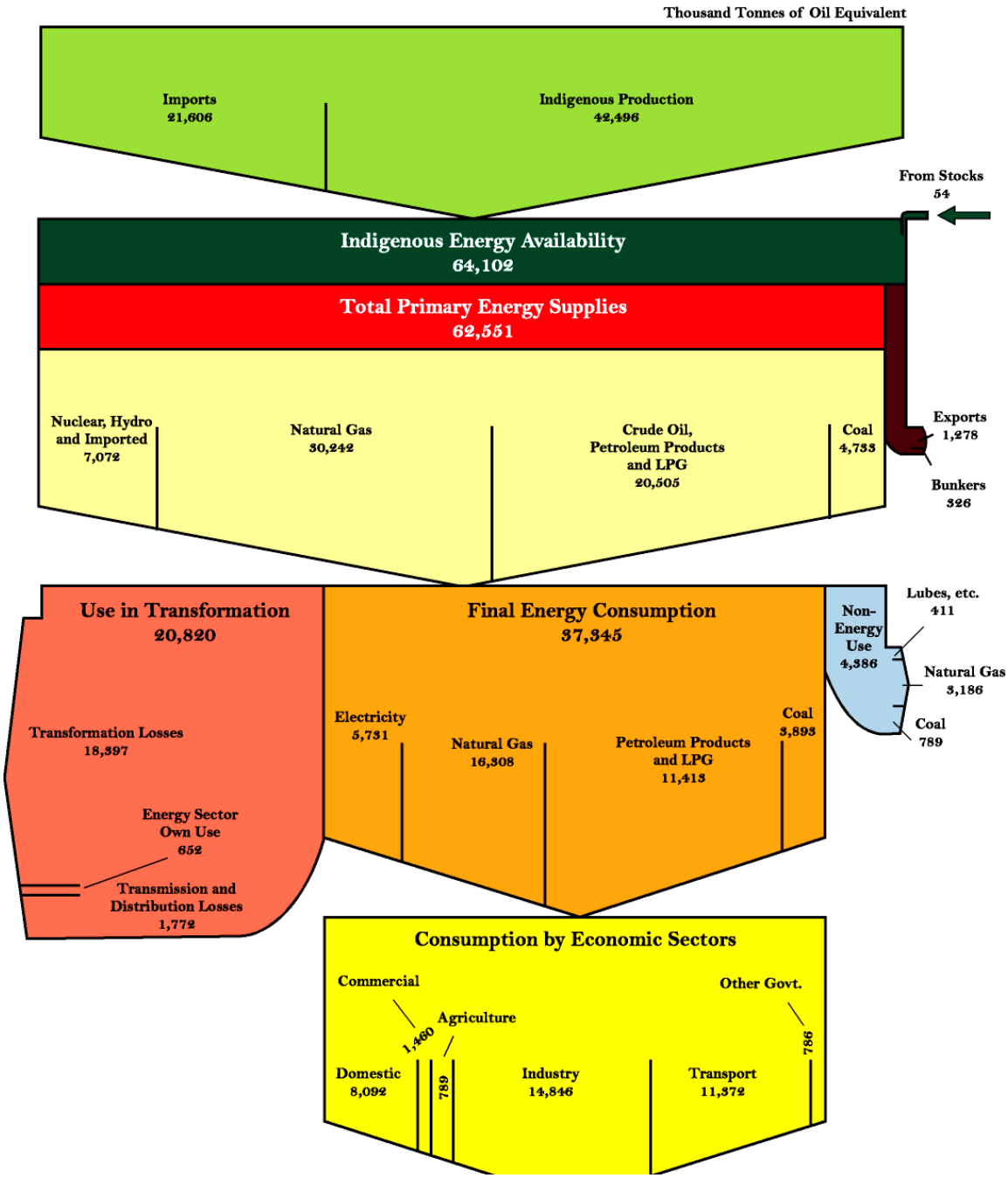
## 1.1 Pakistan's Energy Scenario

Pakistan's energy requirements are potentially huge. Already the world's sixth largest nation with over 160 million people, Pakistan's population is projected to grow at an annual rate of just under 2% is expected to reach 190 million by 2015. At the same time, the country's pace of economic development is accelerating with annual GDP growth averaging 5.2% over the last five years with the size of the national economy and per capita income doubling in less than a decade (Economic Review Report-2009). The significant strengthening of macroeconomic fundamentals and resilience of growth trends even in the face of serious and unexpected challenges, such as record oil import prices and the severe earthquake of 2005 and recent flood of 2010 has underpinned current projections of national economic growth in excess of 8% per year over the medium term and beyond.

These trends translate into rapidly escalating energy demand primary energy supply in Pakistan which has been increasing at 5.4% per annum over the last five to six years for energy supply and use statistics (Economic Survey Report-2009). Over the same period, electricity consumption in the country has risen at an average annual rate of 6.8%, natural gas by 10.4%, liquefied petroleum gas (LPG) by 17.6% and coal by 22.8% (Energy Book-2009). Only oil consumption has leveled off temporarily due to large scale fuel switching in the power and cement industry, displaced by natural gas and coal, respectively and transportation, due to increased use of compressed natural gas (CNG) in vehicles. Nevertheless, oil imports have increased by 4.7% over the preceding year at a 44.5% higher cost due to international crude price escalation. Electricity use in particular, is growing robustly across all sectors industry, agriculture, domestic, and commercial recording a 10.2% overall jump with generation increase lagging behind at 9.3% during the same period. The country thus, faced serious peak electricity supply shortfalls in the range of 2500-3000 MW during the last summer, necessitating significant 'load shedding' or forced outages that adversely affected economic activities and social services. Despite a steady improvement in recent years, system wide transmission and distribution losses still remain high at 24.8% of dispatched power.

# ENERGY FLOW CHART 2008-2009

Source: Pakistan Energy Book-2009



## Table : 1 Primary Energy Supplies By Source

Unit: *TOE*

% Share

| Source | 2003-04 | 2004-05 | 2005-06 | 2006-07 | 2007-08 | 2008-09 | ACGR |
|---|---|---|---|---|---|---|---|
| Oil 1/ | *15,221,024* | *16,329,979* | *16,411,834* | *18,188,280* | *19,206,441* | *20,103,060* | 5.7% |
| | 29.9% | 29.4% | 28.3% | 30.0% | 30.5% | 32.1% | |
| Gas | *25,254,481* | *27,953,380* | *29,169,971* | *29,304,612* | *29,863,194* | *30,241,540* | 3.7% |
| | 49.7% | 50.3% | 50.3% | 48.4% | 47.5% | 48.3% | |
| LPG 2/ | *205,526* | *251,789* | *400,430* | *470,998* | *418,952* | *401,705* | 14.5% |
| | 0.4% | 0.5% | 0.7% | 0.8% | 0.7% | 0.6% | |
| Coal | *3,300,491* | *4,227,842* | *4,049,654* | *4,426,678* | *5,783,844* | *4,732,823* | 7.5% |
| | 6.5% | 7.6% | 7.0% | 7.3% | 9.2% | 7.6% | |
| Hydro Electricity 3/ | *6,431,312* | *6,127,429* | *7,366,452* | *7,626,755* | *6,851,955* | *6,631,841* | 0.6% |
| | 12.6% | 11.0% | 12.7% | 12.6% | 10.9% | 10.6% | |
| Nuclear Electricity 3/ | *420,135* | *667,234* | *592,887* | *546,159* | *734,537* | *386,165* | -1.7% |
| | 0.8% | 1.2% | 1.0% | 0.9% | 1.2% | 0.6% | |
| Imported Electricity 4/ | *17,418* | *26,050* | *34,775* | *40,781* | *47,550* | *54,266* | 25.5% |
| | 0.0% | 0.0% | 0.1% | 0.1% | 0.1% | 0.1% | |
| **TOTAL:** | ***50,850,387*** | ***55,583,703*** | ***58,026,004*** | ***60,604,262*** | ***62,906,473*** | ***62,551,399*** | **4.2%** |
| | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | |
| Annual growth rate | 8.06% | 9.31% | 4.39% | 4.44% | 3.80% | -0.56% | |

1/ Excluding petroleum products exports and bunkering 14.12%

2/ Include imports and production from field plants

3/ Converted @ 10,000 Btu/kWh to represent primary energy equivalent of hydro and nuclear electricity as if this was generated by using fossil fuel

4/ WAPDA imported electricity from Iran since Oct-2002

## Table: 2 Final Energy Consumption By Source

Unit: *T O E*

| Source | 2003-04 | 2004-05 | 2005-06 | 2006-07 | 2007-08 | 2008-09 | ACGR |
|---|---|---|---|---|---|---|---|
| Oil 1/ | *11,145,365* | *11,710,920* | *10,877,601* | *10,575,330* | *11,528,722* | *10,842,614* | -0.5% |
| | 38.5% | 36.5% | 32.0% | 29.4% | 29.3% | 29.0% | |
| Gas 2/ | *10,067,245* | *11,637,566* | *13,325,251* | *14,701,024* | *15,881,990* | *16,307,898* | 10.1% |
| | 34.7% | 36.2% | 39.3% | 40.8% | 40.3% | 43.7% | |
| Coal 2/ | *2,703,906* | *3,310,512* | *3,611,490* | *4,149,041* | *5,404,715* | *3,893,001* | 7.6% |
| | 9.3% | 10.3% | 10.6% | 11.5% | 13.7% | 10.4% | |
| Electricity 3/ | *4,682,063* | *4,994,560* | *5,505,555* | *5,921,635* | *5,977,697* | *5,731,032* | 4.1% |
| | 16.2% | 15.6% | 16.2% | 16.4% | 15.2% | 15.3% | |
| LPG | *380,370* | *450,379* | *625,792* | *658,225* | *619,944* | *569,995* | 8.4% |
| | 1.3% | 1.4% | 1.8% | 1.8% | 1.6% | 1.5% | |
| **TOTAL:** | ***28,978,949*** | ***32,103,936*** | ***33,945,689*** | ***36,005,255*** | ***39,413,069*** | ***37,344,540*** | **5.2%** |
| Annual growth rate | 10.15% | 10.78% | 5.74% | 6.07% | 9.46% | -5.25% | |

1/ Excluding consumption for power generation.

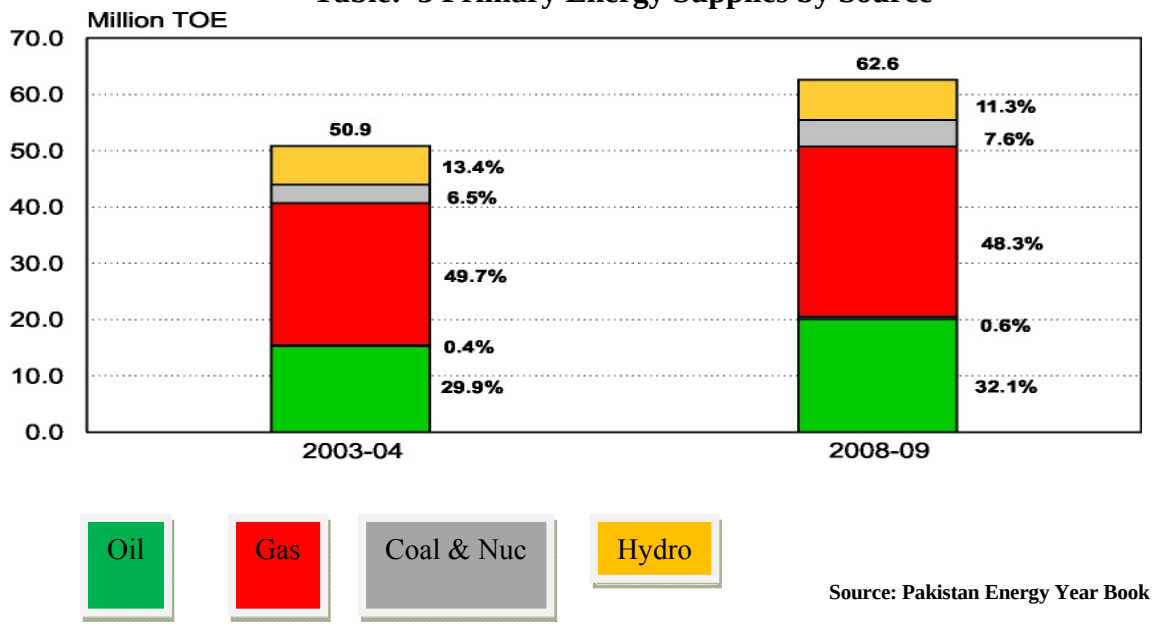
2/ Excluding consumption for power generation and feedstock.

3/ @ 3412 Btu/kWh being the actual energy

**Source: Pakistan Energy Year Book 2009, HDIP.**

Pakistan's Medium Term Development Framework 2005-2010 (MTDF) sets out a challenging programme in order to achieve 8% average annual national GDP growth. The associated increase in energy consumption is projected at 12% per annum, more than double the rate witnessed between 2000 and 2009. This will increasingly strain Pakistan's primary energy supply sources. Rising oil consumption and flat domestic production will once again trigger rapidly increasing oil imports, while declining domestic natural gas reserves in the absence of substantial new discoveries will see the country importing gas for the first time in its history, both through pipelines as well as liquefied natural gas (LNG) shipments. Electricity consumption slated to grow on average per annum to 2015 (although recent experience suggests even higher demand growth) will similarly require large power generation capacity additions. Electricity imports from Iran have been in effect for several years now for the Balochistan coastal grid and larger power imports from Central Asian states to the national grid although logistically challenging are under active Government consideration. Higher energy demand and imports will also require massive investments in associated port terminals, storage facilities, refining capacity, pipeline and transmission networks and surface fuel transport infrastructure. There is increasing realization of the need to expedite exploitation of all indigenously available energy resources, especially the significant Thar coal deposits as well as renewable (small hydro, wind, solar, and biomass) energy, while simultaneously undertaking large hydroelectric projects on the country's main rivers. However, success in efforts to enhance Pakistan's energy supplies is subject to a host of technical, financial, institutional and political constraints. This, however, is being addressed in a timely manner through energy market reforms, privatization of state-controlled institutions, and efficiency.

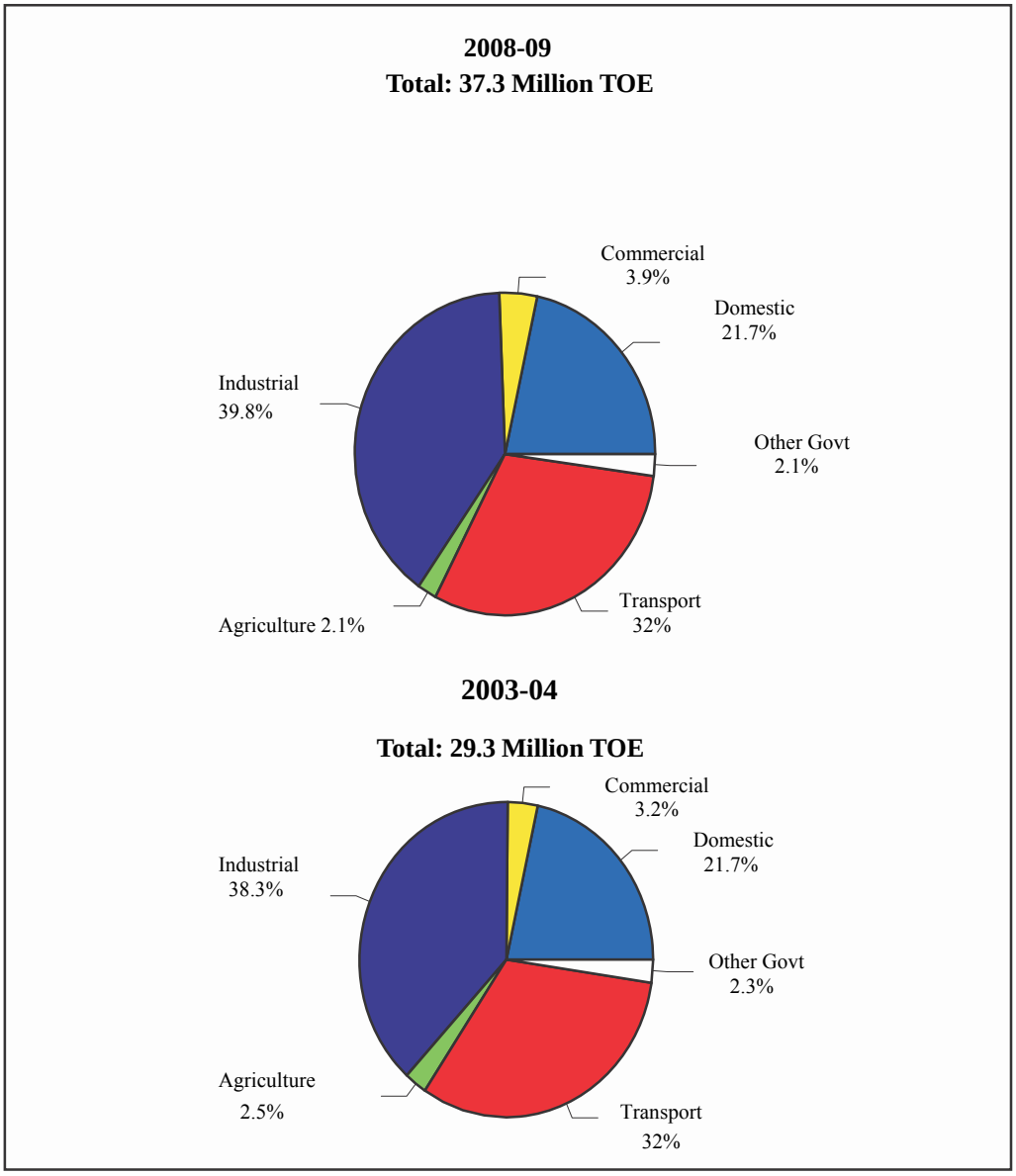
**Table: 3 Primary Energy Supplies by Source**




**Source: Pakistan Energy Year Book 2009, HDIP**

## ENERGY CONSUMPTION BY SECTOR

**(Excluding fuels consumed in thermal power generation)**




Source: Pakistan Energy Year Book 2009, HDIP

### 1.2 The Case for Energy Efficiency

Expanding needs and rising costs make efficient resource utilization and conservation imperative. This is particularly true for the case of increased EE&EC, where the marginal cost of additional supplies is often higher than the cost of affecting savings or improving existing supply utilization. For example, the power from new generators and transmission lines is more expensive that the cost from existing plants and lines, so reducing demand through EE&EC measures is more cost effective than expanding supplies.

Specifically, EE refers to the relationship between the output (service) of a device or a system and

the energy put into it. Improved EE is doing more with equal or less energy input for instance, fewer kilowatts per meter of yarn produced. EE can be evaluated in terms of both first law efficiency and second law efficiency. First law efficiency relates to the ratio of energy input to energy output of a device. Many modern devices have low first law efficiencies, indicating substantial room for improvement. Nevertheless, the best way to understand the full scope for improvement is to consider the second law of efficiency, the ratio of energy input to a device for doing a certain task to the minimum amount of energy theoretically needed to perform that "EE" is defined as economic investments in energy generation, delivery and end-use equipment, facilities, buildings, and infrastructure that deliver higher useful energy outputs or services (e.g lighting, heating, refrigeration, pumped water) with lower consumption of energy and reduced emission of greenhouse gases (ENERCON).

Many EE programmes have an average life cycle cost of US$ 0.03/ kWh saved which is 50 to 75 percent of the typical cost of new power sources (ENERCON). The cost of EE programmes varies by programme and can include higher cost programmes and options with lower costs to a utility, such as modifying rate designs.

EE analysis can be applied at different points in the energy system including energy using equipment, major industrial processes, supply technologies, delivery networks and even urban form and infrastructure. Considering elements of the system together or separately will provide a different picture of EE. Decisions taken about industrial setting energy supply infrastructure and major industrial processes will have long-lasting implications on EE of the system shaping decisions that take place more frequently regarding individual equipment (motors, air displacement systems, lighting, etc).

The term energy conservation is sometimes used interchangeably with the term EE, but in fact they denote distinct concepts. EC expresses actions taken to decrease the demand for energy, which is not limited to demand reductions brought on by increased EE. It could also be used to describe actions taken to reduce consumption of a service (i.e turning off lights). Thus, EE&EC, refer to the entire gamut of first and second law of efficiencies as well as energy demand reduction measures that can be selectively utilized to improve the use of energy in the economy and reduce its intensity of energy use.

Given Pakistan's energy situation the case for making optimum use of available energy supplies and resources through their efficient use and reducing waste is therefore, becoming increasingly compelling for a number of reasons. Rapid economic and population growth are causing a steep increase in energy demand as the country industrializes and standards of living

improve. There is currently a large segment of the population that does not have full access to modern energy services, particularly electricity, which represents significant additional latent demand. As electrification of the country proceeds and transportation infrastructure for other fuels improves this currently unmet demand will further substantially increase national energy supply requirements. Meanwhile, rising incomes have direct correlation with per capita energy use particularly in developing societies such as Pakistan having large human development needs. International experience shows that, for instance per capita electricity consumption grows rapidly until a national human development index (HDI) level of approximately 0.9 is achieved corresponding to a per capita consumption of about 4,000 kWh/year. By comparison, Pakistan had HDI of 0.527 and per capita electricity use of only 176 kWh/year in 2003 which given its large population, indicates huge growth in future energy requirements as the country rapidly develops. Furthermore, Pakistan's demographic profile with roughly a quarter of the population below the poverty line and 39% under fifteen years old points to a spurt, rather than a gradual increase in energy demand and per capita use in the coming years as the working age labor force expands and increasing numbers of the poor gain access to modern energy for the first time.

Pakistan also has the highest and fastest rising levels of urbanization (34.5% in 2004) in South Asia, another strong precursor of increased per capita energy consumption. Because of these factors, Pakistan's energy requirements are expected to grow many fold in the near future even under business-as-usual trends, requiring a significant increase in energy imports as well as expansion of indigenous supplies. Improved efficiency of energy use and conservation in all sectors of the economy can help reduce the overall rate of increasing energy demand to more manageable levels and reduce potential shortages. Meeting these expanding needs will necessitate correspondingly large expenditures on scaling up supplies. With rising oil and gas prices and huge investment needs in import, storage and transportation infrastructure, the strain on Government's public expenditure, balance of trade and foreign exchange reserves on account of servicing the energy sector will be disproportionately large. Already, Pakistan is spending, in 2007-2008, US$ 7.9 billion or 42% of its export earnings on crude oil and petroleum products imports which is expected to increase to US$ 8.8 billion in 2009 due to higher projected oil prices despite roughly the same import volume (ADB Report). Pakistan's proven natural gas reserves will begin depleting in 2010 unless augmented by substantial new discoveries and the country is therefore seriously pursuing transnational gas import pipeline projects and LNG port and degasification facilities in anticipation of the shortfall in domestic production.

Given the scale and complexity of mining and utilizing Pakistan's significant but

untapped coal deposits multibillion dollar investments would be required to economically exploit these resources. Similarly, the country requires substantial investments to undertake long gestation, capital intensive large hydropower development schemes currently planned on major rivers whose costs have gone up significantly because of approval delays and environmental concerns. Major expenditure would also be required to develop new public sector renewable and alternative energy projects and associated facilities, as well as on higher preferential energy purchase tariffs to attract private sector investment in such clean energy supplies. In the power sector alone, these investment requirements are estimated at US$ 150 billion for the additional 143,310 MW of installed capacity required between 2005 and 2030 (ADB Report). Large public and private investments would also be needed for constructing and upgrading gas pipelines and processing facilities, port terminals and storage facilities, refining capacities and road and rail transportation of solid and liquid fuels. Total oil and gas related investments to 2015 for Pakistan are estimated at US$ 16 billion (AFD). Similarly, Pakistan's anticipated financing requirements for meeting its renewable energy development targets to 2015 are estimated to be US$ 2.2 billion. Finally, the state provides vast subsidies for domestic power and gas consumers that undermine optimum use of these valuable resources. In 2007, the subsidy to the power sector alone exceeded US$ 1.3 billion. EE&EC can thus not only reduce the large financial outlays required for developing additional energy supplies in the future but can also help minimize uneconomical 'excess' standby capacity required to cater to peak loads reduce subsidy requirements and defer transmission system expansion needs, thereby saving public funds and increasing returns on energy infrastructure investments.

Besides the financial cost of being a net energy importer, Pakistan's energy supply mix and logistics impose additional economic and external costs on the country. Fuel imports and their transportation and storage strain the nation's already congested ports, highways and depots causing delays and increasing maintenance and upgrade costs. Similarly, the location of main gas and power production centers requires building and expanding long distance transmission networks to major load centers, resulting in excessive transmission and distribution losses and requiring subsidies to keep the cost of service delivery affordable for consumers. Emissions from fossil fuel use contribute to global warming as well as local atmospheric pollution. In particular, the bulk of Pakistan's rural and the poorest urban population still rely heavily on burning traditional biomass (fuel wood, dung, crop residue, etc) for household cooking and heating purposes. This has extremely deleterious health and productivity impacts as the fuel is not only highly inefficient, but also a major contributor to indoor air pollution. Productive time lost to

fuel collection, environmentally unsustainable harvesting of forests and vegetative cover as well as respiratory illnesses and mortality from smoke inhalation, especially amongst women and children is a major contributor to persisting poverty economic stagnation and unemployment, low educational attainment and high healthcare costs amongst large segments of rural population in Pakistan. Low per capita energy consumption, high energy costs and limited access to modern energy services adversely impact human and social development, degrades the environment, undermines poverty alleviation, diminishes quality of life, and seriously retards progress towards achievement of the Millennium Development Goals (MDGs) to which Pakistan is otherwise strongly committed. Modern clean energy supplies and their efficient utilization can help overcome many of these serious additional economic and environmental costs associated with current energy use patterns in Pakistan and significantly accelerate the rate and improve the sustainability of economic and social development in the country especially amongst the large numbers of poor and the economically marginalized.

An important consequence of the in-efficiency of Pakistan's energy resource utilization and service delivery is its impact on the country's economic productivity. In an increasingly globalized environment, a critical measure of an economy's international competitiveness is its "energy intensity," which refers to the amount of energy consumed to produce a unit of GDP. Pakistan's primary energy consumption has in recent year's very closely tracked GDP growth while energy intensity has decreased by less than 5% over the decade 1997-2007 (Energy book-2008). This has two very important implications:

- Energy intensity in Pakistan is presently not falling rapidly enough especially when compared to other emerging economies, notably China and India
- Energy supply cannot keep pace with Pakistan's current strong economic growth

Therefore, in order to preserve economic growth trends and improve its share in the global market, Pakistan will have to target significant reduction in its average energy intensity by adopting efficient energy use and reducing system-wide and end-use waste. In summary, improved EE&EC options offer Pakistan lower cost alternative while supplementing energy supply capacity, reducing end user energy expenditure, improving service affordability, enhancing system reliability and operations, mitigating against environmental impacts and carbon emissions, raising economic productivity, and accelerating social development by creating significant new job opportunities. EE&EC also result in better resource utilization, improved returns on infrastructure investments, and help integrate Pakistan better into the global economy as it grows along a more sustainable development path. In overall economic terms, EE&EC thus represents a 'least-cost'

development strategy for Pakistan that can bring about substantial benefits over the long term. However, lack of concerted EE&EC actions by Pakistan in the past have resulted in the local market for related goods and services remaining underdeveloped despite rising energy tariffs and mounting supply shortages. This, coupled with poor consumer awareness of efficient alternatives, has led to the continuation of wasteful end-use practices and behavior, as well as a growing stock of inefficient energy consuming equipment and infrastructure. Lack of EE&EC-related awareness, technical capacity, product and service availability and effective standards and regulations means that the country continues to lock in long-term energy in-efficiencies in its growing stock of buildings, vehicles, electric motors, industrial equipment, etc. which could at best be subsequently rectified or replaced only partially and at much higher cost. In the absence of readily available cost-effective efficient alternatives, energy consumers and suppliers are also often inadvertently prompted to adopt corrupt cost-reduction methods, such as theft, adulteration, bribery, etc. instead. Such practices once established are not only extremely difficult to root out (as with the experience in efforts to reduce non-technical losses in Pakistan's electricity Transmission and Distribution (T&D) system) but inevitably result in encouraging further energy waste by underpaying consumers, reducing the revenues required by utilities and energy suppliers to invest in expanding and improving service delivery and thus increasing the pressure for further price escalation and motivation for under payment with significant adverse affect on the economy as a whole. If left unchecked, such 'low efficiency' economic growth could ultimately be self-consuming leading to increased shortages and possibly even social strife which would require greater remedial investments. This may also result in ordinate delays in low-efficiency infrastructure that Pakistan can ill afford.

### 1.3 EE&EC Programmes in Pakistan

Worldwide experience indicates that effective implementation and mainstreaming of EE requires concerted and government-led long term action and commitment led that are tuned to market realities across all economic sectors since it is easier and simpler. It is also more expensive to build an additional power plant than to find thousands of places to invest in EE and to ensure a reasonable overlap between those who pay for and those who benefit from such investments.

It is therefore not surprising that Pakistan has so far undertaken only infrequent short lived EE&EC initiatives which have produced mixed results with most gains quickly dissipating soon after termination of external financing due to the lack of sustainable policy, regulatory, institutional and market frameworks to support full-fledged commercialization of EE&EC in the country. Despite a promising start in the mid-1980s in implementing a national EE&EC programme, the country was not able to accelerate improvements in the delivery and end-use of

energy other than those brought about through business-as-usual market and technology developments. Donor support, although important at the programmatic level, has also not been able to result in appreciable national level results. Nevertheless, such external technical and financial assistance have been and remain critical in mobilizing government action and in achieving modest success obtained thus far in implementing institutionalized EE&EC interventions in Pakistan.

### 1.3.1 National Energy Conservation Programme

In 1985, with funding and technical assistance from the United States Agency for International Development (USAID), Pakistan initiated a major national EE&EC programme which has been considered as a role model for emulation by many developing countries. Under the initial phase of the project, a detailed National Energy Conservation Plan was drawn up and an autonomous National Energy Conservation Centre (ENERCON) was established in December 1986 to serve as the Government's focal implementing agency. US-based consultants were engaged under a US$ 9.1 million contract to set up a permanent project office in Islamabad and work in close collaboration with ENERCON in designing and implementing project activities across five main targeted energy consuming sectors: industry, transport, buildings, agriculture and households. The focus of the programme was entirely on energy use efficiency upgrades and conservation.

The first phase of the project concentrated on developing technical content legislative and regulatory requirements, training and outreach, institutional capacity building and identification and demonstration of energy saving opportunities. It accomplished substantial activities in this respect over a five year period. Over 400 technical reports and project studies were produced for use in the local context, 4000 nationwide energy audits and tune-ups were conducted across the country and over 7000 persons trained ranging from corporate managers, technical operators, to service providers and domestic consumers.

The programme however, came to an abrupt termination in 1990 upon the withdrawal of USAID from Pakistan. Originally, under a follow-on phase the project, aimed to

- Achieve full-scale transfer of functional and operational roles from the consultants to their counterpart staff in ENERCON,
- Spin off commercially viable EE&EC activities to relevant market players and Energy Services Companies (ESCOs),
- Institute a supportive legislative and regulatory framework,
- Institutionalize Demand Side Management (DSM) activities, and

- Develop appropriate financing mechanisms to achieve widespread EE&EC buy in and implementation.

The unanticipated end of programme support not only precluded such critical activities from being undertaken, but left ENERCON institutionally stranded and unprepared to continue even its routine functions and established programme elements (audits, workshops, information dissemination etc.) that it had yet to take over from the consultants. As a result, the institution inherited a large stockpile of valuable materials, data, equipment and documented local EE&EC experience along with a network of potential stakeholders that had been meticulously pieced together over the project's previous five years. Little to no capability of utilizing this asset base compounded with uncertain financial support to build up its capacity and no suitable work plan or targets to guide it in re-defining its future role and needs ensued thereafter.

Nevertheless, in 1992, ENERCON prepared the Pakistan National Conservation Strategy and Plan of Action 1993-1998 to support ENERCON's efforts to manage and coordinate the transition from pilot demonstration to nation-wide dissemination phase of EE improvement programmes in Pakistan and to leverage local resources and expertise (including private consulting firms, contractors, manufacturers and suppliers and financial intermediaries, etc.) to deliver EE services in a cost effective and commercially viable manner as originally planned under the second phase of USAID assistance. In addition, the programme was designed to set up a long-term endowment to generate revenues which would enable ENERCON to maintain comprehensive nationwide efforts in Pakistan. Unfortunately, this endowment failed to materialize and ENERCON activities thereafter started to significantly decrease.

Furthermore, a fire at ENERCON's premises in 1992 almost completely destroyed its stockpiled assets and information resources, along with most of its functional office equipment. To make matters worse, bureaucratic instability and leadership conflicts plagued the institution for many subsequent years which along with the loss of local USAID contracted technical staff severely curtailed ENERCON's ability to rebuild itself and continue an effective national EE&EC programme. The institution instead was forced to look towards individual donor-supported projects to help maintain its relevance and finance its technical staff. Thus, from being an apex national body meant to establish nurture and sustain national multisectoral EE&EC implementation and market development, ENERCON had essentially became a project implementation agency with only skeletal resources dependent almost entirely on donor funded initiatives such as, those described below for its financial needs and technical activities. This situation persists largely unchanged to the present day. A lack of sustained political support has therefore led to a situation

in Pakistan where almost all EE&EC relevant materials prepared and institutional capacity developed during the initial period of activity in the '80s has lost its validity due to lack of maintenance and periodic updating. Moreover, valuable skills, experience and lessons learned have been allowed to dissipate to a large extent and will now need to be reconstructed.

### 1.3.2 Fuel Efficiency in the Road Transport Sector

After several years of relative inactivity following the termination of USAID support, ENERCON found itself designated as the national implementing agency for the US$ 7 million Global Environment Facility (GEF) funded 'Fuel Efficiency in the Road Transport Sector (FERTS) project in 1996. The project was designed to help improve automobile engine tune-up standards and fuel efficiency in the country's growing but ill-maintained fleet of vehicles through modern computerized diagnostic centers and better trained auto technicians. Under this project, which lasted until 2005 and for which short-term technical staff resources were provided to ENERCON, 50 auto diagnostic and tune-up centers were established at commercial gasoline stations throughout the country. Some 900 workshop owners and 2000 auto mechanics were trained in their proper use through workshop courses. Several technical studies were also conducted on issues specific to transportation energy use in Pakistan.

The project also conceived a revolving line of credit, the Energy Conservation Fund (ECF) for financing private sector EE&EC investments in the country at concessional rates for which GEF provided US$ 3 million of seed money with matching grants to be provided by the Government. However, because of the predominant role of FERTS in ENERCON's operational activities during the decade 1995-2005 and the agency's failure to resurrect its EE&EC programmes and capacities in other sectors, the conclusion of this project once again left the institution unable to continue effectively as the driver for a national broad-based EC and efficiency strategy. Loss of FERTS project staff has meant that even project based initiatives in the transport sector have come to a standstill. In particular, the ECF remains completely unutilized and as of 2007 ENERCON had not been able to institute functional fund management and loan disbursal arrangements for it.

### 1.3.3 Programme on Renewable Energy and EE

In 2006, the German development cooperation, Gesellschaft fur Technische Zusammenarbeit GmbH (GTZ) began a technical assistance programme in Renewable Energy and Energy Efficiency (PREEE) and identified ENERCON and National Productivity Organization (NPO) as the focal counterpart agencies for the EE part of the project. The main thrust of this programme is to develop the technical and management capacity within these institutions as well as amongst other public and private sector stakeholders to enable them to play their roles more

effectively. Initially, the programme is focusing on improving EE in the largest industrial sub-sectors (i.e textile spinning, weaving) and in assisting ENERCON in the design of a domestic appliance EE labeling scheme. GTZ is also helping ENERCON in accordance with the Government's Energy Conservation Policy 2006 to develop a national EE&EC action plan based on a consultative and participatory approach. Based on activities undertaken in these areas, GTZ hopes to implement demonstration EE projects in industry, develop the capacity of industry and consultants to better assess and implement EE, and manage energy use and raise general market awareness about EE measures and services. It also aims to strengthen and operationalize the ECF build academic EE&EC programmes and provide the Government with relevant policy inputs. The programme is currently expected to continue for at least three more years with an initial funding of € 3.2 million for both the RE and EE segments. Thus, although on a reduced scale, this project replicates in many respects the original USAID-funded institutional development of ENERCON. However, it does not provide for the necessary resource and staff augmentation within ENERCON which would be required for the agency to continue and sustain the donor provided momentum in the post project period. For this purpose, additional commitments need to be mobilized and put in place in consonance with the programme schedule.

### 1.3.4 Awareness Campaign on Energy and Environmental Conservation

ENERCON also occasionally undertakes a modest number of industrial energy audits and tune-ups awareness and training campaigns and development of technical documentation (including an update of the Pakistan Building Energy Code) under the Government's Rs 39 million National Awareness Campaign on Energy and Environmental Conservation (ACE) initiated in 2003. However, the number, scale and frequency of such activities are insignificant in the national context and ENERCON has not devised targets or timelines for scaling them up to meaningful levels.

### 1.3.5 National Environmental Action Plan Support Programme

As part of the United Nations Development Programme (UNDP) implemented National Environmental Action Plan Support Programme (NEAP-SP), limited funding has also been provided to ENERCON from 2002 to 2006 for undertaking industrial and small-scale EE demonstration activities. As with the ACE project, this supplemental funding is insufficient for any sustained EE&EC objective other than to enable ENERCON to conduct occasional events that achieve little more than limited publicity for the organization. Consequently, these activities neither catalyze greater interest in EE&EC or help realize direct rupee-for-rupee energy savings as a result nor serve as precursors to expanded interventions by ENERCON itself.

### 1.3.6 New and Planned Initiatives

More recently, several new initiatives for revitalizing EE&EC activities in Pakistan have emerged due to renewed Government interest in the wake of increasing energy demand and import costs. Initiatives have also started amongst the donor community in light of the slowing down efficiency which hampers the country's economic development potential.

For instance, the Asian Development Bank (ADB) has included Pakistan in its regional Energy Efficiency Initiative (EEI) launched in 2006. The Bank has undertaken a framework analysis to help define a future demand-side EE&EC assistance strategy to the country to be financed through a major loan programme under US$ 1billion a year EEI funding. In this respect, national action and investment plans along with project pipelines are slated to be finalized by the ADB for which country level consultations have already begun at the Planning Commission. On the supply side, the ADB has launched a US$ 800 million multitranche financing facility (MFF) under its Power Transmission Enhancement Investment Programme for Pakistan to help improve electricity transport infrastructure and reduce transmission and distribution losses in the country.

USAID has also been implementing the South Asian Regional Initiative (SARI) project in several South Asian nations (excluding Pakistan) since 2000 which has a major component focusing on the energy sector. Under the current phase of the SARI Energy Cooperation and Development (SARI/Energy) programme begun in 2007, Pakistan has been included as a recipient of technical assistance. The programme focuses on regional approaches to meet South Asia's energy security needs including energy trade, EE, rural energy supply, regulatory issues and energy statistics. Under its previous phases, SARI/Energy focused on developing regional appliance standards and labeling programmes as well as the promotion of ESCO’s in the private sector.

Discussions are also underway between the Government and several bilateral development partners for initiating EE&EC technical and financial assistance. These include the formation of a US-Pakistan Working Group on RE and EE to design a multi-year cooperation plan as well as expressions of interest by the European Union and the Republic of France for starting EE&EC-focused assistance programmes in Pakistan.

Utility led Demand Side Management (DSM) programmes have not yet been explored properly in Pakistan. In anticipation of severe power shortage for the summer of 2008-2009, the Ministry of Water and Power (MoWP) has directed Water & Power Development Authority (WAPDA), Karachi Electric Supply Corporation (KESC) and various Distribution & Supply Companies (DISCOs) to encourage DSM practices amongst its consumers. In addition to power factor penalties in effect for many years in consumer billing, WAPDA has recently introduced time-

of-day (ToD) tariffs for industrial and agricultural loads. However, a proper assessment of the impact of the later measure has not yet been conducted.

Due to the significant increase in instances of 'load shedding' (forced outages due to power generation shortfalls) in large cities, the Government has mandated enforcement of a strict 8 pm closing time for most retail commercial establishments in the country as a temporary measure to help curtail evening load peak. This was met with some resistance from store owners, led to difficulties of uniform enforcement and will in the near future be challenged by new large scale commercial development projects. Reliance on such ad hoc command and control measures rather than market-based EE&EC mechanism is symptomatic of the lack of systematic long-term energy supply and management planning by the government and the absence of efficiency regulation in a booming consumer economy where energy demand is fast outpacing supply.

# 2. Existing EE&EC Framework and Market in Pakistan

## 2.1 Institutional Framework

Pakistan's energy sector is administered largely through federal government ministries and agencies. Provincial government involvement is restricted to small-scale power generation (<50 MW capacity plants) to exploration and mining leases for natural resources other than oil and gas (i.e coal) to permitting for renewable energy projects (wind, hydro etc)

### 2.1.1 Government Agencies

The following provides a list of government agencies directly or indirectly relevant to the management and development of Pakistan's energy policies, resources, infrastructure and end use. The Planning Commission is responsible for overall energy planning and infrastructure development in the country. It is supported by the Energy Wing of the Planning and Development Division for technical advice and approval of all public sector energy investments.

The Ministry of Water and Power (MoWP) is the Government's executive arm for all issues relating to electricity generation, transmission and distribution, pricing, regulation and consumption in the country and exercises this function through its various line agencies as well as relevant autonomous bodies and utilities. It also serves to coordinate and plan the nation's power sector, formulate policy and specific incentives and liaise with provincial governments on all related issues. Through the Private Power and Infrastructure Board (PPIB) and the Alternative Energy Development Board (AEDB), the Ministry provides private investors with one-window facilities for undertaking conventional and renewable IPPs respectively.

The Pakistan Atomic Energy Commission (PAEC) an autonomous agency is exclusively responsible for the country's civilian nuclear power programme.

The Ministry of Petroleum and Natural Resources (MoPNR), likewise, administers the oil and gas sector through its various technical directorates. Oil and gas exploration and production policies, concessions and licenses are managed by the MoPNR, while those for other minerals including coal are the preserve of provincial governments. The Hydrocarbon Development Institute of Pakistan (HDIP) is the principal Government agency for compiling national energy statistics as well as for R&D in fossil fuel applications.

The Ministry of Environment (MoE) through the newly established CDM Cell is the Designated National Agency (DNA) for Clean Development Mechanism (CDM) projects in the country and for climate change related policies and activities. The Pakistan Environment Protection Agency (Pak EPA) also serves as one of its line agencies and technical arms. ENERCON is responsible for promotion of EE&EC in the country.

The Ministry of Science and Technology (MoST) through its various line agencies is also

engaged in energy related research standardization, and certification. Other ministries, such as those for industries, communications, railways, housing and food and agriculture are relevant for energy use in these sectors, including policies incentives and facilities for improving EE. City planning and building regulation are functions of local governments and municipal administration bodies.

Finally, the Ministry of Finance and Revenue (MoFR) defines and approves all financial and fiscal terms and incentives applicable to the energy sector including the tax and customs regime (through the Central Board of Revenue (CBR), investment terms, income and profit repatriation, etc. MoFR through its Economic Affairs Division also coordinates all external assistance and financing to the energy sector in the country.

**Table: 4 Government Agencies Relevant to Energy Production and Management**

**Planning Commission (PC)**

| |
|---|
| • Planning and Development (P&D) Division (Energy Wing) |
| • Ministry of Water and Power (MoWP) |
| • Water and Power Development Authority (WAPDA) |
| • Private Power Infrastructure Board (PPIB) |
| • Alternative Energy Development Board (AEDB) |

**Ministry of Petroleum and Natural Resources (MoPNR)**

| |
|---|
| • Directorate General, Gas (DGG) |
| • Directorate General, Oil (DGO) |
| • Directorate General, Mineral (DGM) |
| • Directorate General, Petroleum Concessions (DGPC) |
| • Hydrocarbon Development Institute of Pakistan (HDIP) |

**Ministry of Environment (MoE)**

| |
|---|
| • National Energy Conservation Centre (ENERCON) |
| • CDM Cell |
| • Pakistan Environmental Protection Agency (Pak EPA) |

**Ministry of Science and Technology (MoST)**

| |
|---|
| • Pakistan Council for Renewable Energy Technologies (PCRET) |
| • Pakistan Council for Scientific and Industrial Research (PCSIR) |
| • Pakistan National Accreditation Council (PNAC) |

**Ministry of Industries, Production, and Special Incentives (Mol)**

| |
|---|
| • Pakistan Industrial Development Corporation (PIDC) |
| • Engineering Development Board (EDB) |
| • National Productivity Organization (NPO) |
| • Small and Medium Enterprises Development Authority (SMEDA) |

**Ministry of Textile Industry (MoTI)**

**Ministry of Communications (MoC)**

| |
|---|
| • National Transport Research Centre (NTRC) |
| • National Highway Authority (NHA) |

**Ministry of Railways (MoR)**

| |
|---|
| • Pakistan Railway |

**Ministry of Finance and Revenue (MoFR)**

| |
|---|
| • Finance Division |
| • Federal Board of Revenue, FBR |
| • Economic Affairs Division (EAD) |

**Ministry of Food, Agriculture, and Livestock (MoFAL)**

| |
|---|
| • Pakistan Agriculture Research Council (PARC) |
| • National Agriculture Research Council (NARC) |

**Ministry of Housing and Works (MoHW)**

| |
|---|
| • Public Works Department (PWD) |
| • Pakistan Housing Authority (PHA) |

**Ministry of Defence**

| |
|---|
| • Pakistan Armed Forces |
| • Paramilitary, Border, Airport, and Maritime Security Forces |
| • Civil Aviation Authority (CAA) |
| • Pakistan International Airlines Corporation (PIAC) |
| • Pakistan Meteorological Department (PMD) |
| • Ministry of Defence Production |
| • Defence Production Division |
| • Pakistan Atomic Energy Commission (PAEC) |

**Provincial Governments**

| |
|---|
| • Planning and Development Departments |
| • Irrigation and Power (I&P) Departments |
| • Mines and Mineral Development Departments |
| • Environment Protection Departments |
| • Resource Development Corporations/Authorities |
| • Municipal Administrations and Local Government |

### 2.1.2 Utilities and Energy Providers

Following is the list of relevant energy utilities and service providers in Pakistan and the institutional organizations of the supply market:

**Power**

The power market in Pakistan is undergoing significant long-term structural reforms with the ultimate objective of introducing a deregulated and efficient industry operating on competitive market principles with the full participation of the private sector in all aspects of infrastructure and service provision. The Water and Power Development Authority (WAPDA), the erstwhile national power utility, has recently been unbundled into separate generation, transmission and distribution entities while the vertically-integrated utility serving the Karachi region, the Karachi Electric Supply Corporation (KESC), has been privatized. These corporative entities have been registered with the Securities and Exchange Commission of Pakistan (SECP) and are managed by their respective boards of directors. A significant Independent Power Producers (IPPs) and captive power generation capacity is also operational in the country completely replacing new public investment in thermal power production with planned private investment also increasing in wind and small hydro projects. IPPs consist of 16 thermal producers in operation with several more in the pipeline including the country's first hydroelectric IPP project. WAPDA continues to oversee the construction and operation of large and medium sized hydroelectric dams for power production as well as manage their use for irrigation through its Water Wing.

**Oil and Gas**

The oil and gas industry in Pakistan consist of a mix of private and public sector entities that fall under the policy and administrative control of the MoPNR are regulated by the Oil and Gas Regulatory Authority (OGRA). Within the MoPNR, the office of the Director General of Petroleum Concessions (DGPC) is responsible for the award and management of oil and gas

exploration and production licenses in the country under the Government's petroleum policy which is revised from time to time (the July 2009 version is currently in effect). The Oil and Gas Development Corporation (OGDC) and Pakistan Petroleum Ltd (PPL) are the two state-owned exploration and production companies that are together responsible for about 54% of oil and 44% of natural gas production in the country. The balance production of oil and gas is accounted for by about 11 companies in the private sector with additional companies engaged in exploratory drilling. The Directorate General of Oil (DGO) is responsible for the administration of oil refining, import, distribution and retail operations in Pakistan. The Pakistan State Oil Company (PSO) accounts for about 70% of the retail oil market with the bulk of the balance shared by three private sector companies. The Sui Northern Gas Pipelines Ltd (SNGPL) and Sui Southern Gas Company Ltd (SSGCL) are state-owned corporations that together account for over 79% of the gas transmission and distribution operations in the country. Independently owned pipelines dedicated to supplying lower calorific value gas to power and fertilizer units account for the remaining business. The Director General of Gas (DGG) in the MoPNR is responsible for policy making and administrative management of natural gas, LPG, and CNG industry in the country. The LPG and CNG business is almost entirely owned and managed by the private sector. The government is considering import of LNG in both the public and private sectors under the LNG Policy.

**Coal**

Development and utilization of coal resources falls under provincial government jurisdiction, while actual mining and sales are carried out largely by the private sector with some public sector participation. The country's large lignite deposits at Thar are under the aegis of the Sindh Coal Authority moving beyond preliminary stages of mine ability assessment to more detailed test pit evaluation and will likely eventually involve foreign investments for full scale commercial exploitation. Coal is also imported by private companies as well as large consumers such as the Pakistan Steel Mills for its cooking needs.

**Nuclear**

The Pakistan Atomic Energy Commission (PAEC) builds and operates the country's civilian nuclear power plants and conducts related fuel production, engineering and maintenance, training and R&D through an elaborate network of specialized subordinate institutions and agencies employing a large pool of skilled manpower.

**Renewables**

Small hydro development has principally been undertaken by provincial agencies, such as the Sarhad Hydro Development Organization (SHYDO), the Northern Areas Public Works

Department (NAPWD), and NGOs such as the Aga Khan Rural Support Programme (AKRSP) primarily in the mountainous north of the country. A number of grid-connected wind IPPs are in late stages of project approval but none have achieved financial closure so far. Some pilot and demonstration scale activity is also underway in biomass conversion and waste-to-energy based power generation while the country's sugar industry engages in bagasse based electricity production for self use as well as for sale to the grid.

**Table: 5 Energy Utilities and Suppliers**

**Electric Power**

| |
|---|
| • Thermal, Hydro, and Nuclear Generation |
| • Generating Companies (Thermal, 4) |
| • Independent Power Producers (Thermal, 16) |
| • Water and Power Development Authority (WAPDA Hydro) |
| • Small Power Producers (Thermal) |
| • Pakistan Atomic Energy Commission (Nuclear) |

**High-Tension Transmission**

| |
|---|
| • National Transmission and Dispatch Company (NTDC) |

**Low-Tension Distribution**

| |
|---|
| • Distribution Companies (9) |

**Oil and Gas**

| |
|---|
| • Exploration and Production |
| • E&P Companies (26) |
| • Pakistan Petroleum Exploration and Production Companies Association (PPEPCA) |

**Oil Pipeline Companies**

| |
|---|
| • Pak Arab Refinery Company (PARCO) |
| • Asia Pipelines Limited (APL) |

**Oil Refineries**

| |
|---|
| • Pak Arab Refinery Company (PARCO) |
| • National Refinery Limited (NRL) |
| • Pakistan Refinery Limited (PRL) |
| • Attack Refinery Limited (ARL) |
| • Bosicor Pakistan Limited (BPL) |

**Oil Marketing Companies**

- Pakistan State Oil Company Limited (PSO)
- Shell Pakistan Limited (Shell)
- Chevron Pakistan Limited (Caltex)
- Total-PARCO Pakistan Limited (Total)
- Attack Petroleum Limited (APL)
- Private Companies (4)

**Gas Transmission and Distribution Utilities**

- Sui Northern Gas Pipelines Limited (SNGPL)
- Sui Southern Gas Company Limited (SSGC)
- Mari Gas Company Limited (MGCL)

**LPG Companies (58)**

**CNG Companies (5,476)**

**Coal**

- Thar Coal Company Limited
- LakhraCoal Development Company Limited
- Coal Importing Companies

**Renewables**

- Small Hydro
- Sarhad Hydro Development Organization
- Punjab Irrigation and Power Department
- Northern Areas Public Works Department
- Aga Khan Rural Support Programme

**Regulators**

The regulatory framework for the energy sector in Pakistan is relatively new and in the process of consolidating powers and acquiring technical sophistication. The National Electric Power Regulatory Authority (NEPRA) was established in 1997, Oil and Gas Regulatory Authority (OGRA) in 2002, and Pakistan Nuclear Regulatory Authority (PNRA) in 2001. These autonomous agencies to varying degrees are in need of internal capacity building but otherwise fully functional and with their roles established in price and procedure setting, licensing, performance and safety standards, operational accounting and implementation of rules and

penalties. Coal mine leases and operations are regulated by the provincial government's mineral development corporations/authorities.

In addition, several other regulatory agencies are also relevant to energy related activities in Pakistan. The Pakistan Environmental Protection Agency (Pak EPA) established in 1984 is the apex regulatory body for all aspects relating to the quality of air, water, natural resources and social environment in the country and functions under the Ministry of Environment. Provincial EPAs are responsible for such functions within their geographical jurisdictions and may augment the regulations set at the federal level.

The country's central bank, the State Bank of Pakistan regulates monetary policy and financial institutions sets prudential guidelines defines foreign exchange transaction and repatriation rules and provides foreign investment risk cover and guarantees where applicable. The establishment certification and regulation of metrology performance and quality standards and testing is carried out by the Pakistan Standards and Quality Control Authority (PSQA) formed in 2000. It consists of the Standards Development Centre (SDC), the Quality Control Centre (QCC), and Technical Services Centre (TSC). Its effectiveness in instituting EE Standards for equipment and materials however, is presently very limited. Buildings and urban planning and energy use therein is regulated by the respective municipal administration of each city which are funded by the local government which is also directly involved in land use planning, zoning, and infrastructure investments.

**Table: 6 Relevant Regulatory Agencies**

| | |
|---|---|
| **Electric Power** | |
| | • National Electric Power Regulatory Authority (NEPRA) |
| **Oil and Gas** | |
| | • Oil and Gas. Regulatory Authority (OGRA) |
| **Nuclear Power** | |
| | • Pakistan Nuclear Regulatory Authority (PNRA) |
| **Standards** | |
| | • Pakistan Standards and Quality Control Authority (PSQCA) |
| **Environment** | |
| | • Pakistan Environmental Protection Agency (Pak EPA) |
| | • Provincial EPAs/EPDs |

**Urban Planning and Services**

| |
|---|
| • Local governments |
| • Municipal administrations |

**Monetary and Prudential**

| |
|---|
| • State Bank of Pakistan (SBP) |

### 2.1.3 Market Suppliers and Service Providers

The retail and services EE&EC market in Pakistan consisting of the categories delineated below has so far been largely driven by routine technological improvements and brand competition (such as in consumer appliances, space conditioning, industrial equipment, vehicles etc) that incidentally result in efficiency gains or by increasing demand for EE&EC products and services (such as compact and strip fluorescent lamps, CNG kits, vehicle tune-ups etc.) spurred by steadily rising energy prices (i.e retail electricity tariffs, gas and LPG, petrol and diesel etc).

There is presently no consumer appliance EE labeling or energy performance standards scheme in place in Pakistan and public awareness in this regard is generally limited to manufacturer or vendor claims. Similarly, thermal and energy performance data on building and construction materials is not readily available and knowledge of energy saving building design principles and methods is highly variable amongst architects, builders and developers, building owners and occupants. Residential building EE&EC practices are largely confined to roof insulation and some passive design considerations; while larger commercial buildings may employ HVAC simulation software and fluorescent lighting often losing any real efficiency gains on these accounts to overly conservative sizing poor usage and maintenance practices. While large industrial units may occasionally conduct internal energy audits and some degree of internal energy management, the market for such services is very limited and therefore such expertise is not readily available or affordable by the large number of medium- to small-scale and cottage industry in the country. Financing constraints, in addition, typically force the smaller industrialists to employ outdated, worn out or ill-maintained machinery with low up-front costs but high life-cycle energy consumption.

ENERCON's FERTS programme has introduced the concept of computerized vehicle diagnostics and tune-ups in the country, but the number of workshops offering such facilities with trained manpower is small and limited to the larger cities only, in particular, modern workshop facilities for large privately owned diesel vehicles (buses and freight haulers) are virtually non-existent. Agricultural extension services have not fully incorporated tractor and tube well efficiency upgrades into their portfolios and most such equipment is thus operated and maintained

using traditional inefficient techniques, tools and practices.

Although some of the larger cities in Pakistan are switching over to efficient high pressure sodium streetlights, there are no detailed energy-related guidelines or regulations adopted by municipalities to incorporate EE&EC into functional zoning and urban development, transportation infrastructure and systems, building regulations or other aspects of modern efficient city planning and design. For this reason, for instance, Pakistan continues to be home to some of the largest cities in the world without functional mass transit systems.

Finally, lack of an established EE&EC market also does not allow designers, architects, engineers, ESCO's and firms specializing in EE products and services from developing a significant presence which in turn erodes awareness, interest, and commercial demand for energy efficient solutions. The absence of mandatory regulations facilities for related investments in all energy consuming economic sectors and a supportive policy framework that encourages and rewards EE collectively preclude demand for EE&EC products and services in the country with a few exceptions noted above from achieving the critical mass necessary for a commercial EE&EC manufacturing and servicing industry and related infrastructure to develop. Therefore, for the reasons the EE&EC market in Pakistan can be described as underdeveloped but with a high potential for rapid growth in terms of both volume and technical capacity.

**Table: 7 EE&EC Market Suppliers and Service Providers**

| |
|---|
| • Consumer appliances |
| • Building materials, lighting, and HVAC suppliers |
| • Industrial Energy Efficient vendors |
| • Agricultural Energy Efficient vendors |
| • Vehicle diagnostics and tune-up services |
| • Municipal and urban services |
| • Consultants, designers, engineers and architects |
| • Alternative energy providers |
| • Energy services companies (ESCO's) |

### 2.1.4 Financing

Pakistan's financial sector is well established and regulated. Commercial banking in particular is a growing, healthy and sophisticated industry in comparison to other countries in a similar or even more advanced stage of development. The capital market is also amongst the best performers amongst the emerging economies of the world. Every year Pakistan receives substantial multilateral and bilateral assistance for its development needs including concessional lending for

investments in infrastructure and clean energy. For instance, in 2006 Pakistan was the second largest recipient amongst Developing Member Countries of loans, grants and technical assistance from the ADB after the People's Republic of China, totaling US$ 1.58 billion. ADB's assistance for EE project is slated to increase to US$ 6 billion.

In terms of concessional and commercial financing specific to EE&EC investments however, the Pakistani market is vastly underdeveloped and credit is not readily available for such purposes particularly to small and medium-sized borrowers. Under the FERTS project, ENERCON established a revolving line of credit in 2002 with an initial US$ 3 million GEF grant initially meant for vehicle tune-up and diagnostic facilities but later renamed the Energy Conservation Fund (ECF) to include other EE&EC financing requirements of the private sector. However, by mid-2007 the fund had still not been made functional due to delays in appointing financial intermediaries for loan disbursements as well as establishment of a proper fund management structure and operational criteria.

The concept of micro financing is recent in Pakistan, but strongly supported by the government and NGO community. The Khushali Bank was established in 2000 under the Government's Microfinance Sector Development Programme (MSDP) with assistance from ADB to provide a countrywide network of branches reaching out to small borrowers. NGOs are also actively engaged in expanding microfinance facilities in the country, although financing specifically for EE&EC purposes is relatively rare. The country is also only beginning to realize the benefits of clean energy financing mechanisms such as the CDM and as yet has not developed a strong portfolio of eligible projects or institutional capacity to exploit the emerging carbon trade market. Given the sophistication of the local financial sector, it can be assumed that such facilities can be rapidly developed once the local demand for and awareness of EE&EC investments increases.

**Table: 8 EE&EC Financing in Pakistan**

**Concessional (Government)**

| |
|---|
| • Energy Conservation Fund (ECF) |
| • Small and Medium Enterprise Development Authority (SMEDA) |

**Concessional (Donor)**

| |
|---|
| • Multilateral (e.g., ADB, the World Bank, UNDP/GEF, etc.) |
| • Bilateral (e.g., GTZ, ADF, etc.) |

**Commercial Banks**

**Microfinance Institutions**

**Clean Development Mechanism (CDM)**

## 2.2 Policy and Regulatory Framework

### 2.2.1 EE&EC Policy

The Pakistan National Energy Conservation Policy was approved in 2006 to provide broad guidelines for enhancing end use efficiency in various energy consuming sectors of economy. The policy lays out the following as its main strategic goals:

- **Sustainable development** through use of least-cost and environmentally friendly energy supply options
- **Improved economic productivity** and poverty alleviation through optimum utilization of available energy supplies
- **Environmental protection** by offsetting greenhouse gas and other polluting emissions from avoided energy generation and use
- **Gender mainstreaming and social development** in rural and remote communities through EE&EC supplemented energy supplies.

These goals are to be met through the following specific initiatives which comprise the operational objectives of the policy:

- Promotion of EE&EC and improved energy management in all sectors of the economy
- Development of EE&EC market and commercialization of relevant products and services
- Enhanced utilization of available indigenous energy resources and reduced dependence on imported fuels
- Reduced energy intensity through efficient practices, technology upgrades, and waste reduction

For the industry and power, transport, building, household, agriculture, alternative and renewable energy sectors, the Policy separately defines short, medium and long term measures for meeting overall policy objectives and goals for delineating the time frame division between the two. The document also lists some action areas in this respect such as the formulation of EE&EC specific legislation and regulations provision of appropriate incentives, capacity building and awareness raising etc, but does not indicate how these are to be achieved (i.e specific provisions and incentives, sequencing and timing, agencies responsible etc). In this respect, the policy document resembles more of a statement of intent on the part of the Government rather than an enabling instrument for encouraging EE&EC investments, market development and consumer behavior change. Furthermore, the policy draft was developed internally by ENERCON and does not appear to have involved extensive external stakeholder consultation and therefore remains largely

without broad institutional ownership and appropriate implementation mechanisms, although ENERCON itself is currently engaged in translating the policy directives into a corresponding National Action Plan 2010.

### 2.2.2 EE&EC Legislation

In October 2003, ENERCON drafted the National Energy Conservation and Management Ordinance and presented it to the Ministry of Environment. In this Ordinance, ENERCON was designated as the principal federal agency responsible for exercising powers and performing functions in the EE sector. Energy conservation centers were also to be set up at the provincial government level. The proposed Ordinance included a comprehensive set of programmes and regulation tools, such as energy reporting for large energy consumers, energy audit formats applicable to energy reporting, appliance efficiency labeling, energy consuming equipment testing, and standards. Penalties for contravention to the Ordinance, energy tribunals and appeal procedures were also included.

However, despite three separate attempts by ENERCON to help formulate and revise national legislation for supporting and facilitating EE&EC activities in the country and the Federal Cabinet's approval of a draft as early as 1990, the Pakistani legislature has not yet pass any law on EE&EC (ENERCON has re-drafted the Energy Conservation Bill-2010 and is with Law & Justice Division for legal implications). This acts as a significant deficiency in promoting an energy efficient culture and practices in different sectors of the Pakistani economy. Importantly, the absence of such legislation prevents the development of a secure EE&EC investment climate in the country by undermining essential market and financial guarantees that would otherwise be predicated on a compelling legal and regulatory framework as well as decreasing the motivation amongst concerned agencies to develop facilities, incentives, institutional support and consumer awareness appropriate for energy efficient practices.

However, development of appropriate legislation is contingent on the existence of clear and coherent policy guidelines on the subject on which such laws can be based and which they can seek to provide a legal and regulatory basis to implement. The absence of effective comprehensive EE&EC policy framework, thus, has and will continue to be a major impediment to designing a responsive legal and regulatory regime that can help translate national EE&EC objectives into actual stakeholder action.

In the Asia-Pacific Region, several countries have adopted National legislation for the promotion of ECE&EC. Australia. Indonesia, Thailand, China, India are among these countries. Pakistan may join this group and take advantage of their experience in designing appropriate legislation that fits both the immediate and long-term national energy situation and helps mitigate

the critical negative impact of energy use on the environment. Equally, the legislative framework should also carefully address how such a law is to be managed and funded if it is to be an effective tool for implementing the National EE Policy.

### 2.2.3 EE&EC Regulations, Codes, Standards and Certification

Given a virtually non-existent EE&EC specific policy and legislative framework, it is not surprising that in terms of relevant EE&EC regulations, performance codes, construction and manufacturing standards and corresponding certification requirements. Pakistan remains seriously deficient even by similar developing country status. This situation is a major contributor to the under developed state of the local EE&EC market as regulatory requirements are often the main drivers for the wide-scale adoption and acceptance of EE investments and upgrades which in turn spur the growth of a local EE&EC product and service industry. Equally, where incipient or piecemeal regulations exist, the lack of uniform enforcement and certification significantly hampers their effective implementation and erodes realized energy saving benefits. Furthermore, given the status and expected growth of the national economy, the lack of appropriate EE&EC regulation can result in potentially huge future energy losses as inefficient machinery, vehicle, consumer appliance, lighting and building stock is rapidly procured, constructed or installed, spurred by increasing industrial investment, building activity and consumer incomes. The following measures essentially constitute the existing framework relevant to EE&EC specific regulation in Pakistan.

**Building Energy Use**

Under the USAID-funded National Energy Conservation Programme, ENERCON developed in collaboration with the renowned Lawrence Berkeley Laboratory of the US Department of Energy the Pakistan Building EE Code for residential and commercial buildings along with a compliance handbook detailing technical design and material data in 1990. At the time of its publication, it was acclaimed one of the most comprehensive building EE&EC regulations in the developing world and subsequently served as a model followed by many other countries. In Pakistan, it was initially designed to be introduced on a voluntary basis through related awareness raising for architects and engineers by means of training workshops. It was supposedly made mandatory for larger buildings.

However, due to the abrupt termination of the USAID programme, this goal could was not realized. Awareness about the code and actual compliance by the building industry remained negligible in the following decades. ENERCON was assigned the task of updating the code and compliance manual to the National Engineering Services of Pakistan (NESPAK). Finally the Building Energy Code was approved by Pakistan Engineering Council in Nov 2010 and will be

implemented initially on voluntary basis.

**Boiler Operations**

In terms of industrial EE, the Pakistan Boiler Act of 1923 is the only equipment-specific regulation in place. This out-of-date piece of regulation relates primarily to boiler safety which requires proper operational and maintenance practices for better energy performance. However, no EE&EC specific regulation, standards, or certification requirements exist relating to other aspects of industrial combustion or steam systems and controls or other electrical and energy consuming industrial equipment.

**Power Factor (PF) Penalties**

Low (<0.9) power factor penalties at industrial electricity connections have been in place for some time and widely implemented through separate kVAr meters installed at the consumer bus bar. Although the penalty mechanism is automatically implemented through the billing system, consumer awareness and access to proper power factor correction equipment and advice are often problematic, especially for mid to small-sized industrial units. As a result, while the PF charge may help the utility to recoup its financial losses on account of the excess generation required to service reactive loads on the grid, this may not result in the actual potential energy savings.

**Time-of-day Electricity Tariffs**

More recently, power utilities in Pakistan have introduced time-of-day (ToD) based electricity tariffs for industrial and agricultural connections. First limited to large (>20 hp) agricultural tube wells, they were met with little success due to paucity of large capacity motor-pump sets in many distribution regions that otherwise had large cumulative tube well loads (e.g the main agricultural areas of the Punjab). Subsequently, ToD rates were extended to industrial connections where metering of this kind could be carried out. However, the full impact and evaluation of this important EE&EC measure has yet to be determined. ToD meters required have only recently become available to utilities in sufficient numbers and are now being installed at all new connections while replacement of existing connections continues. The ToD surcharge and discount relevant to the baseline tariff also needs to be carefully evaluated in order to elicit optimal shifts in consumption load profiles to off-peak periods.

**Daylight Savings Time**

In 2002, Pakistan introduced Daylight Savings Time (DST) for the first time in history to achieve electricity consumption savings. However, the measure which was met with public controversy and resistance was discontinued the same year. The Government subsequently

announced that it would not implement DST in the following years as the expected energy saving results from the experiment had not materialized (although the analysis on which this observation was based was not ever revealed). During the energy crisis of 2007-2008, the Government once again announced DST during summer season. It was implemented for almost two years before it was discontinued in 2010 because of the same public controversy and resistance.

**Quotas and Restrictions**

Although energy use in the country is not regulated, Pakistan, from time to time, has resorted to mandatory energy quotas and usage restrictions when faced with severe supply constraints. These include forced outages (load shedding) where the supply of network electricity and natural gas itself is deliberately rationed out to 'low' priority consumer categories to manage seasonal generation and production shortages or grid imbalances due to excess loads. Mandatory usage restrictions include for example, the requirement of commercial building and outlet close of business timings and a ban on advertisement billboard lighting use in 2010. Such supply and usage regulation represents an extreme coping mechanism. This method, however, represents a simplistic and ad hoc approach to energy use management which extracts real and unaccounted for economic cost far beyond the direct impact of disruption which can instead be better managed through more sophisticated pricing, DSM, and EE&EC regulations.

### 2.2.4 Other Policies, Regulations, and Statutory Instruments

Other national policies, regulatory measures and legislation that impact the production and use of energy in Pakistan include the following:

- National Conservation Strategy, 1992
- National Environment Policy and Action Plan, 2005
- National Environment Quality Standards (Revised), 1999
- National Forest Policy, 2001
- Pakistan Environment Protection Act, 1997
- Pakistan Petroleum Policy, 2009
- Policy for Development of Renewable Energy for Power Generation, 2006
- Policy for Power Generation, 2002
- Small and Medium Enterprise Policy, 2006

In addition, the National Transport Research Centre (NTRC) is currently preparing a national policy for road transport 2010. A draft has been prepared for approval including measures for system-wide efficiency improvements.

### 2.3 Supply-side EE Market

Between 2008 and 2009, Pakistan's primary energy was supplied by gas (50%), oil (29%), hydro electricity (12%), coal (7%), nuclear (1.2%) and LPG (0.4%). Technical and non-technical losses in the power industry have been widely documented and improving the situation through investment is presently the subject of significant efforts. Efficiency in the gas industry is generally less considered even though its role in Pakistani economy is significant with supply problems already anticipated in the future**.** These rationalize the inclusion of the gas sector in future EE policy formulation.

#### 2.3.1 Gas Sector

Natural gas occupies a very significant place in Pakistan's commercial energy supply. It meets 57% of the requirements of the domestic sector, 58% for the commercial sector, 52% for the industrial sector (which could be even higher minus forced winter supply curtailment), 9.5% for the transportation sector, and 70% of the fuel used in thermal power generation (Energy Book-2009).

The gas industry in Pakistan is not externally subsidized but it includes internal cross subsidies. The price of gas paid to producers is dictated by the Government through OGRA and is 50% to 60% of the fuel oil 'basket' price. Gas prices are subsidized for the residential sector and the utilities rate of return is guaranteed since the industrial and commercial sector bear these costs through higher tariffs. The cost of gas nonetheless represents only 55% of alternative fuel oil price for industry; whereas for the residential sector, it represents only 35% of alternative fuel price. In such conditions, it is not surprising for instance, that solar water heaters have hardly displaced gas-fired heaters in the local market. As national gas reserves begin declining in 2010 as per current estimates, it is anticipated that increased gas imports will result in higher consumer prices and the rise in gas demand should slow down.

Load management by gas utilities includes the use of transmission pipeline storage capacity as a buffer to meet daily and weekly demand peaks. Space heating is a necessity in the northern half of Pakistan during the winter. This creates a national winter peak demand for gas resulting in supply to the industrial sector being cut down to meet the increased domestic demand. As this is a routine occurrence, affected consumers are generally equipped accordingly by substituting other fuels during this season.

Another tool which gas utilities is reverting to is increased DSM campaigns. On a monthly consumption basis, all customers including the domestic sector have to pay a much higher tariff (at 30 to 40% higher rates) for consumption over a standard demand level. The

SNGPL in particular has recently been conducting effective information and awareness programmes directed at educating consumers about avoiding higher tariff rates through simple device management and use practices that help avoid wasteful consumption.

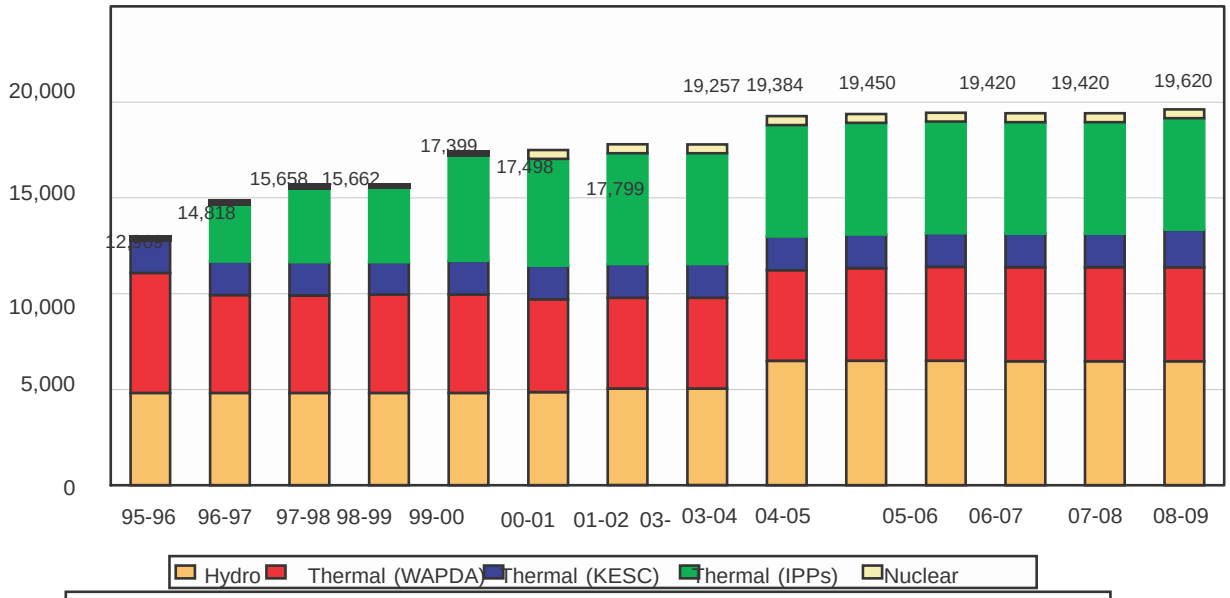
In urban and rural areas which are not connected to the gas pipeline network, LPG is the preferred substitute and is sold at its economic cost. As it is the poorer areas that generally lack pipeline gas connection, it is also the poorer strata of the urban and rural population that has to rely on non-subsidized LPG. Those that cannot access or afford it resort to traditional biomass fuels. In conclusion, it can be seen that the gas industry is actively conducting programmes to match available gas supply to demand through better management, pricing structures and heightened consumer awareness. These are positive elements upon which to build future EE&EC programmes on in the gas sector.

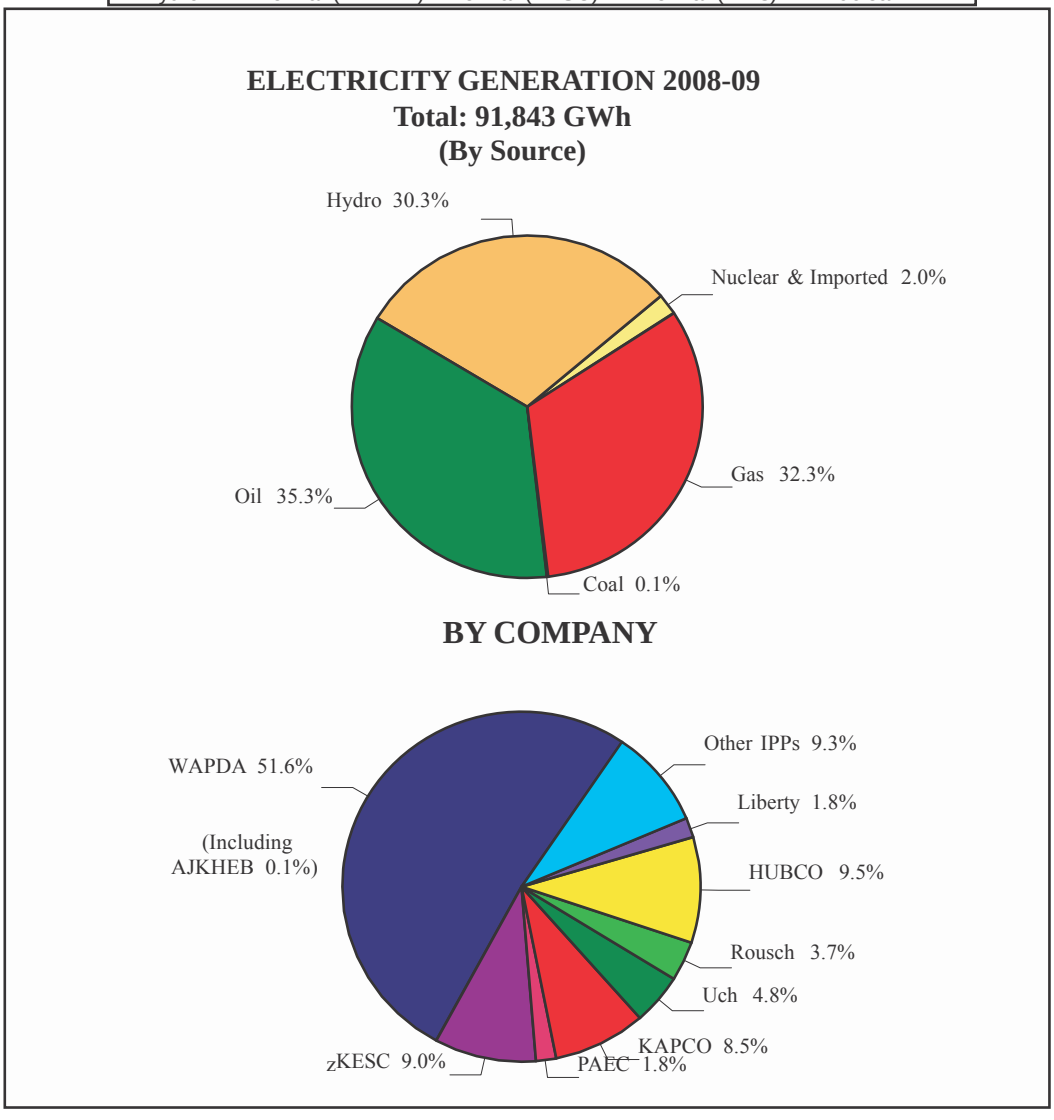
### 2.3.2 Electricity Sector

**Power Generation**

The installed electricity generation capacity in Pakistan in 2009 was 19,620 MW, for which the primary energy sources utilized were natural gas (32.3%), hydro (30.3%), oil (35.3%), nuclear (2.0%), and coal (0.1%) (Energy Book-2009).

## Table: 9 Electricity Installed Capacity



**Energy Consumption**

In 2008-2009, Pakistan's final energy consumption of about 37.3 million tons of oil equivalent are met by mix of gas, oil, electricity, coal and LPG sources with the different levels of shares. During the same period, the share of gas consumption stood at 43.7% in total energy mix followed by oil 29.0%, electricity 15.3 %, coal 10.4 %, and LPG 1.5% (Energy Book 2009). Furthermore, this energy consumption mix has witnessed significant changes since 2003-2004 with major consumption sources of gas increasing by 9% during 2008-2009 compared to 2003-2004 while oil consumption share declined by 9.5%. These changes in consumption of gas and oil mainly owed to shift from imported expensive fuel to relatively cheaper source of gas. Furthermore, the share of coal consumption increased due to its higher production during this period. The shifting of energy consumption towards indigenous resources saves the considerable amount of foreign reserve during this period.

To meet future electricity demand, power generation is expected to grow to 162590 MW by 2030, or an average of 5700 MW per year (ADB Report). This could be a real challenge for the economy and provides a significant reason to seriously include EE in the scheme to minimize the need for additional power supply as well as the risk and economic costs of not being able to reach this installed power capacity target.

**Transmission and Distribution (T&D)**

In March 2009, national transmission level power losses (including transformation and grid stations losses) were at 8% of the net generated power, an increase over 2008 where losses were calculated to be 7.6%. In the same month, losses in distribution added up to 18.2% and 19.1% as compare to last year. Total T&D losses amounted to 26.2% in 2008 and 26.7% in 2007 (MoW&P). T&D losses are a mix of technical and non-technical losses. Technical losses require technical measures to bring them down to an acceptable level. Non-technical losses are a consequence of mismanagement and illegal connections, which privatization of distribution companies is hoped to significantly contribute in addressing. In the meantime, important efforts to improve the situation are being made with modest year-on-year improvements.

As part of its infrastructure development efforts, the Government has initiated an important investment programme to improve electricity T&D system. This programme is to be implemented between 2010 and 2019 at a total cost of US$ 3.9 billion of which the ADB under its Power Transmission Enhancement Investment Programme for Pakistan is providing US$ 800 million (AFD). The World Bank and four Electricity Distribution Companies (DISCOS) are presently preparing a project to reduce secondary T&D energy losses. The DISCOS have prepared their component evaluation that includes both technical investments and administrative/managerial measures. Losses in DISCOs have been estimated in one case to decrease from 15% to 12.2% and in another from 25% to 21.5% (Planning Commission Report).

### 2.3.3 Alternative and Renewable Energy Sector

Pakistan has not yet been able to successfully attract significant private sector investments in renewable energy generation. AEDB, the body created specifically for this

function, has so far focused almost exclusively on wind power IPPs which have been dogged by tariff disputes and other operational issues even though substantial additional incentives have been on offer from the Government (e.g concessional land leases, wind speed risk cover, power evacuation guarantees, fiscal exemptions etc). However, it is anticipated that these issues will be eventually resolved and at least a handful of wind IPPs will be able to break ground in the coming years.

Small hydro schemes have traditionally been the preserve of provincial governments with several hundred micro hydro turbines having been installed primarily in the northern mountainous regions by SHYDO, NAPWD and AKRSP. ADB has recently processed a loan of US$ 110.4 million for eight run-of-the-river mini and small hydro projects, both high and low-head, in the Pukhtonkhwa and Punjab, while its private sector financing is involved in the first medium sized hydro IPP in Pakistan, the US$ 125 million 84 MW New Bong Escape project in Azad Jummu Kashmir (AJK). These pioneering projects are expected to set the stage for private sector involvement in tapping Pakistan's large hydroelectric potential (estimated to be up to 45,000 MW) based on large rivers, smaller tributaries and mountain streams and the country's extensive irrigation canal system (WAPDA).

The New Zealand government is currently financing a pilot scale biomass conversion and power generation project at the Landhi cattle colony in Karachi based on methane production from animal waste, which has substantial scaling up and replication potential in the country. Some initial assessments for municipal solid waste-to-energy and landfill methane recovery are also being conducted in major cities. The country has recently experimented with limited sales of ethanol-blended gasoline in Karachi, Lahore and Islamabad. Biomass, waste and bio-fuel resources represent a promising future alternative energy market for Pakistan, depending on how quickly the Government can develop the necessary policy and support infrastructure for private sector participation.

The market potential is particularly high for exploiting solar energy (both photovoltaic and thermal systems) where current deployment of such systems is very limited. Recently introduced net metering and sales permitting which allow sale of surplus small-scale generation to the grid (when properly developed and paired with suitable end-user financing) could open up a huge market for rooftop PV panels in Pakistan, especially in grid-connected localities for servicing non-time critical and daytime loads (water pumping, fans, etc.). This could help supplement electricity provision, shift peak loads and reduce consumer bills. Thermal water heating (again in combination with gas heating) could also be accepted by both gas utilities and their domestic customers. Commercial use of RE (in industry and large buildings) could also be implemented through a combination of incentives support products and services and appropriate regulations.

## 2.4 Demand-side EE Market

### 2.4.1 EE&EC Market Situation

The status of EE implementation in Pakistan is presently inadequate but there is a

general consensus in the community of managers and decision-makers, that it is now time to bring in a strong EE&EC policy regime. This does not mean however that managers and energy users understands the concepts of EE&EC. In fact, the suggested programmes and strategies to improve EE had little coherence or implicit relationship since basic EE&EC policy strategy and planning were mostly limited to generic suggestions. This lack of knowledge about EE policy and programme design is a consequence of the low profile EE&EC leadership in the country in the past two decades and the sharp discontinuities in the nature and pace of previous EE&EC promotion activities in Pakistan.

Equally, reduced efforts in EE have resulted in a very limited information base about the nature and size of the demand-side EE&EC market in Pakistan. ENERCON has prepared some broad energy conservation potential estimates by sector, but the basis or details for these are not available. More recent government planning estimates have included scenarios for a 9% reduction in national energy demand on the basis of EE&EC activities alone over the base case by 2025, calculated on 7.5% savings in electricity consumption and 5% in gas use in the industry and transport sectors (ENERCON).

**Table: 10 Estimated Potential Sector wise EE&EC Savings in Pakistan**

| | |
|---|---|
| Industry | 15-25% |
| Transport | 15-20% |
| Agriculture | 15-20% |
| Buildings | 20-30% |
| **Average** | **15-25%** |

**Source: ENERCON, National Energy Conservation Centre**

It is not specified for instance, if the data in Table 10 refer to the technical, economical or market potential. Even though these data show similarities with potentials identified in other countries, they are mere indications and can hardly be considered as representing the actual energy conservation potential in Pakistan. What they indicate mostly is the almost total absence of EE&EC potential data and the correlated necessity to build up from scratch a comprehensive database for planning, monitoring and evaluating future EE&EC policies and programmes. To minimize data collection and maintenance costs and accumulate experience in a long term perspective, this database should be under the responsibility of a central agency with the support and contribution of all stakeholders.

### 2.4.2 DSM by Power Utilities

While supply side energy management involves the planning and construction of new generating supply, T&D facilities to meet electrical requirements, DSM refers to measures that modify end-use consumption. Generally DSM programmes are designed to modify either the level or pattern of electricity usage reducing overall consumption through improved EE or modifying the usage profile through load management. However, DSM can also involve the strategic addition of new loads.

At the macro level, the goal of DSM is to optimize energy resources. The primary objective is to lower total societal costs. Extended objectives include environmental

improvement and increased economic competitiveness. Broader social objectives, such as benefiting economically deprived segments of society through reduced costs or provision of services are sometimes also considered.

At the local level, DSM can be employed for more specific purposes. These usually involve the avoidance or deferral of new electricity supply facilities with the associated cost savings. Where supply constraints are immediate, DSM can be used to maintain system capabilities or to free up capacity to serve new presently unconnected customers. DSM can be implemented in a number of ways and involve:

- Direct load control by the utility
- Modifying customer usage through pricing signals
- Providing monetary incentives to end-users to change behavior or end-use equipment
- Regulatory changes, such as setting efficiency standards for equipment
- Market development changes, such as educating end users or developing suppliers of end-use energy products and services

In most countries, DSM has been developed and administered by utility companies with varying levels of government agency involvement and private sector participation for delivery of services.

**DISCO Experience in DSM**

The transmission and distributing companies have shown a good understanding of what impact DSM could have on their businesses and profitability in terms of improved capacity of their existing T&D grids inter-alia. However, Islamabad Electric Supply Company (IESCO) past and ongoing DSM initiatives have been examined and show that a methodology to build up and manage a DSM programme has not been systematically adopted. The experience of other DISCOs within the WAPDA system seems to be very similar. The simple reason for this is a general lack of knowledge and experience in DSM programme design and implementation amongst the power utilities. After a short presentation was made about what DSM is and how it would fit in DISCOs' day-to-day management, IESCO promptly expressed a strong interest to get support and training to implement such a programme in their company.

**2.4.3 Industrial Sector**

The industrial sector represented 39.8% of the total commercial energy consumption in Pakistan during 2008-09. Energy supply to industry was based on oil products (11.6%) gas (52.7%) electricity (11.1%) and coal (24.6%). In 2008, the total number of industrial electricity connections in Pakistan was over 226 000 of which 99% had loads less than 70 kW supplied through the 11 kV and 440 V distribution network. The balance of industrial consumers was supplied through dedicated feeders and accounted for about 52% of the total consumption in the industrial sector. The share of industry in total electricity consumption in Pakistan has decreased over the past ten years and is currently 28% for WAPDA and 36.7% for KESC, compared with 34.7% and 40% respectively. From the turn of the century, Pakistan has entered a strong economic development period. Between

2000 and 2007, the industrial sector improved its share of GDP from 22.6% to 24.5%, whereas agriculture declined from 26.2% to 23.3%. The manufacturing sector increased from 14.8% in 2002-2005 to 17.5% in 2006-2008 with private sector real investment in large-scale manufacturing registering a 25.4% increase in 2005-2006. This decreasing portion of the industry in the total electricity demand apparently does not seem to fit this economic evolution (GTZ Report).

Explanations for this seeming anomaly could perhaps be identified through a survey ENERCON is presently conducting to build up a database on energy use in the industrial sector. In fact, this will probably not be possible. The initial methodology adopted for this data gathering was to survey the totality of industries. Getting data from industries presented great difficulties. It was initially designed as a comprehensive industry survey but has now transformed into a limited sampling of companies that willingly agree to provide their energy consumption data. The resulting database will therefore not be statistically representative or provide reliable data upon which to build up monitor and evaluate future EE&EC programmes and strategies addressing this important segment of the energy consumption.

For the country as a whole, EE&EC activities in the Pakistani industrial sector have been moving at a very slow pace in the recent past, the possible exception being large scale export-oriented private industry. Services and information on industrial energy audits and tune-ups, upgrades and retrofits, operational and maintenance practices, awareness and training and efficient equipment supplies and funding is generally scarce with ENERCON playing only a very nominal role in filling these gaps. However, given Pakistan's strong industrial growth rates, increasing globalization pressures on production costs, rising energy supply, and security concerns, there is a significant latent demand for such services in the industrial sector and time is opportune to initiate a strong programme in collaboration with market players in order to sustain economic growth and keep the nation competitive.

**GTZ Industry Initiatives**

As part of plan for Pakistan, Gesellschaft fur Technische Zusammenarbeit GmbH (GTZ) conducted a € 3.2 million Renewable Energy and EE Technical Assistance (TA) with AEDB and ENERCON. ENERCON along with UNDP has also launched a project in May 2010 for Barrier Removal to the Cost-Effective Development and Implementation of Energy Efficiency Standards and Labeling Project (BRESL) based on the National Energy Conservation Policy 2006, as well as providing EE&EC assistance to industry with focus on textiles and devising programme for appliance EE testing and labeling. The textile industry is the most important industrial sub sector in Pakistan. Based on locally available raw cotton (Pakistan is the world's fourth largest cotton producer), thus industry is the largest industrial employer and brings in most of the foreign exchange earnings into the country. It contributes to 68% of total exports. However, the textile industry is fast losing its advantage in raw material prices since energy and credit costs are raising the costs of production considerably. GTZ and SMEDA (Small and Medium Enterprise Development Authority) have set down the following objectives for EE programme for the textile industry;

- Raise awareness with respect to industrial EE
- Conduct/facilitate industrial energy audits
- Prepare a sector study on potential savings and best practices in EE
- Institute industrial training including train-the-trainer programmes
- Build capacities of local consultants with specific reference to EE through this programme, several barriers to EE in textiles production have already been identified

Electricity is available to about 50% of Pakistan's population and the average consumption per household is currently 172 kWh per month. More than 80% of households with access to electricity had incomes of less than Rs 6000 a month and consumed on average 60 kWh per month; 14% of electrified households with household income of up to Rs 7500 a month consumed on average 180 kWh per month; the remaining 6% are urban households that can afford air conditioners and other appliances consuming an average of 1650 kWh monthly (ADB Report).

Electricity tariff rates for household/residential consumers are still subsidized by the Government. Based on data provided by WAPDA and electricity distribution companies the average rate for residential users was Rs 3.34/kWh (less than US$ 0.06/kWh) during fiscal year 2005-2006. The cost of supply to households was well in excess of US$ 0.08/kWh. In 2008, this subsidy translated into an annual cost of over Rs 80 billion for the Government (NEPRA). This is a situation where using EE&EC programmes as buffer may help public authorities to increase household tariffs to their true economic value.

### 2.4.5 Commercial Sector

In the period 2008-2009, the commercial sector consumed 3.9% of total commercial energy supply in Pakistan, consisting of LPG (26.8%) gas (8%) and electricity (7.3%). For electricity, this sector had over two million consumers with an estimated 92% of small and medium-sized shops consuming approximately 60 kWh per month. It is possible however, that a significant number of commercial establishments are currently registered as 'residential' to take advantage of the subsidized tariff.

### 2.4.6 Transportation Sector

In year 2008-09, Pakistan became the second largest user in the world of CNG as a transportation fuel, with 1.55 million vehicles or a quarter of the total number employing this technology on its roads. In 2006, Pakistan consumed 130 million cubic feet per day natural gas for transportation, which formed 10% of all road transport fuels, while gasoline constituted 14% and diesel oil 76%. There are currently over 2000 CNG fueling stations in the country, 65% of which are dedicated CNG-only stations while 35% are co-located with liquid fuels with 200 more under construction and some 4 000 new license applications pending. CNG is a lead free fuel with negligible sulfur and particulate emissions. It emits 70% less carbon monoxide and 87% less oxides of nitrogen than gasoline. It produces 25% lower carbon dioxide emissions as compared to petrol and diesel oil (HDIP).

The development of the CNG industry in Pakistan has been achieved not through

government directives but through market-oriented policy instruments and consumer choice. The Hydrocarbon Development Institute of Pakistan (HDIP) initiated the process with two demonstration pilot project stations. Higher gasoline prices gave a solid push to the market for switching from gasoline to CNG. Other policy incentives, such as deregulated price of CNG, liberal licensing, investor friendly institutional support, tax and duty exemption on conversion kits and dispensing equipment were equally responsible for this dramatic success.

Both users as well as private investors have been quite enthusiastic and responsive to the CNG policy regime. As a result, an investment of over US$ 500 million has been made by the private sector, mostly small and medium enterprises in establishing the required infrastructure for refueling, conversion and manufacturing about 28 000 new jobs have been created in this industry.

Under the GEF-funded Fuel Efficiency in the Road Transport Sector (FERTS) project, ENERCON helped establish about 50 auto diagnostic and tune-up centers at commercial gasoline stations countrywide and conducted relevant trainings. However, programme activities have come to a standstill since the end of the project in 2005 and given the rapidly growing automobile industry in the country, this represents only a nominal intervention in eliciting better vehicle maintenance practices in the country. In 2007, with ADB support, the National Transport Research Centre (NTRC) has started developing a national policy for road transport, presumably including efficiency measures. Draft of the national policy has already been presented for approval.

### 2.4.7 Agriculture Sector

Electricity consumption in the agricultural sector is mainly for tube wells used for irrigation and for the control of salinity and water logging. The bulk of agricultural consumption is in the WAPDA system. Agricultural consumers account for about 11.6% of total electricity consumption in the country. High growth rates in electricity demand were seen in this sector during 1985-1989 (e.g 27.3% in 1998) and were primarily due to the introduction of a flat rate agricultural retail tariff. There were negative growth rates during 1998 to 2000 as the utility withdrew flat rates for the tube wells and most of the private tube wells converted to diesel oil operation (NEPRA).

In 1992, ENERCON conducted a study of the sector. Statistics showed more than 300 000 agricultural tube wells installed in Pakistan which include both electric and diesel tube wells. One year's figures only for diesel pump sets showed the total diesel oil consumption to be 0.50 million TOE. Similarly, the electrical energy consumed per year by tube wells amounted to about 4 500 GWh. This means that about 1 million TOE was consumed by agricultural tube wells in a year. ENERCON surveys have indicated average efficiencies to be low of the order of 5-7% for diesel tube wells and 20-22% for electric tube wells. Attainable energy efficiencies in the range of 20-25% and 40-45% for diesel and electric tube wells respectively are possible. This implies that there is a potential for energy savings through tube well efficiency improvement involving minor retrofit measures and upgrades.

## 2.5 Energy Pricing

The price of energy should ideally reflect its environmental externalities. This measure though hardly implemented anywhere with much success as it faces enormous political and societal resistance implies that governments would have to modify the tariff structure for energy (typically electricity) and reduce un-necessary subsidies on energy. If done, such an approach should always be undertaken as a combined policy initiative in concert with other EE programmes. Several industrialized countries have gained experience in recent years with taxes on non-renewable energy resources. This tax revenue can be re-channeled to support EE&EC measures for buildings, clean public transport systems, DSM programmes and other EE measures and technologies. Other fiscal incentives could include tax rebates for EE expenditures and rebates on appliances like refrigerators and fluorescent lightning (especially where electric power utilities are publicly owned) which help to disseminate and promote energy efficient products and equipment. As in a number of countries in the world, energy pricing remains a chronic issue. In Pakistan, higher international primary energy prices have brought urgency to bridge the gap between domestic and international prices and relative price distortions between different forms of energy. The Government has been reluctant to price energy to reflect its economic cost because of its concern about the adverse effects of energy price increases on industrial competitiveness, household budgets, (especially those of low income families) and on inflation in terms of both its direct economic effects and its longer term social and political ramifications.

### 2.5.1 Electricity

In terms of implications for EE, the pricing policy in Pakistan's power sector is not optimal on both the supply and demand sides. On the supply side NEPRA is responsible for fixing the purchase price of power from producers. In the 1990's, a stimulating pricing policy was adopted and independent producers entered the market. From 10500 MW in 1992-1993, power production capacity in the country grew to 17500 MW in by 2001-2002 (NEPRA). By 2002, these incentives were watered down and power capacity grew at a much slower pace. At that time there was some surplus capacity still available in the system and the increasing electricity demand was easily provided. This situation did not last for long, as generation installation stagnated while the economy and consequently electricity demand picked up rapidly.

Presently, Pakistan is experiencing a severe electricity shortage with pipeline projects insufficient to resolve the crisis in the near future. Load shedding is a daily reality in the country and the supply situation will probably become worse before new capacity is put in operation to meet ever growing demand. Power supply planning obviously needs to be improved in Pakistan and plans are afoot for ADB to assist in setting up a long-term integrated energy planning capacity within the Government. In the meantime, a large number of private industries continue to install their own captive power production facilities to escape frequent and unpredictable load-shedding and to keep their operations ongoing. In 2007, the Government allowed such plants to sell their surplus power to the grid in order to augment overall supply and capacity utilization.

On the demand side, tariffs are uniform all over the country for each category of customer in each DISCO region. This precludes the true delivered price of electricity from being charged to the consumer, which induces waste and un-economic use of the resource. However, the DISCOs' purchase price from the NTDC is based on the system wide average cost of production, while NEPRA determines an appropriate consumer tariff for each DISCO. The difference between the differentiated NEPRA determined consumer tariffs and the uniform, Government notified ones actually charged to the customers are paid as subsidy to DISCOs. In this manner, the residential base-level consumption is subsidized and industrial and commercial sector consumers pay high tariffs to compensate for the difference. The impact of this tariff structure is generally negative in economic terms as it creates higher demand from and reduces EE&EC incentives for the residential sector increases the cost of production and business for the industrial and commercial sectors and significantly impacts on public finances in the form of a recurring annual power sector subsidy of over Rs 200 billion in 2009 payable by the Government to the PEPCO.

### 2.5.2 Natural Gas

The price for non-associated natural gas is indexed to the Carriage & Freight prices of a basket of imported Arabian/Persian Gulf crudes and presently is 50 to 60% of this reference price. The cost of gas for industry is 55% of the crude oil and 35% for the residential sector. As gas imports are to increase in the near future, the average market price is also expected to increase and consumers will have to adjust to it. EE programmes in the gas sector could take advantage of this context where support in adapting to the increasing resource price will be needed. Where the natural gas distribution grid is not present, LPG is substituted. This generally is the case in poor urban and rural areas. The market price for LPG is its economic price without subsidy.

### 2.5.3 Petroleum Products

Oil refineries are certified a certain take off price for their products. As diesel fuel meets a large percentage of transport requirements (70% in 2008-2009), its production is improved through a 10% premium in its take off price paid to refiners over the international market price. Gasoline bears no such benefit (OGRA).

### 2.5.4 Alternative Energy

The pricing for alternative energy in Pakistan has been a contentious issue. This is primarily because neither NEPRA, the body that determines commercial power tariffs for grid connected power, nor the AEDB meant to facilitate alternative and RE investments in the country have as yet undertaken a proper economic and comparative analysis of various RE options in the local context including their external and marginal avoided costs. In the absence of such a basis, the determination of tariffs on a cost-plus formulation based on dynamic market prices of generation equipment becomes subject to debate, while absolute RE power purchase figures are often incorrectly compared with corresponding conventional generation rates that do not account for hidden subsidies for the later or the external benefits of clean RE. Under the Policy for Development of Renewable Energy for Power Generation 2006, the Ministry of Water and Power issued

guidelines for the determination of wind and small hydro IPPs using such a formulation on which basis NEPRA has since issued tariff notification for several private sector wind power producers the range of US$ 0.095-0.105/kWh, but these have not yet resulted in any proposed projects from achieving financial closure (MoW&P).

In light of the above, there is a strong case for undertaking a more comprehensive valuation of such alternative energy pricing, including from additional sources presently not addressed (biomass conversion and waste-to-energy, solar etc) which takes into account Pakistan's current power generation market, as well as properly accounts for external costs and benefits including environmental and carbon credits, peak load reduction and reduced T&D losses that smaller dispersed renewable energy generation can bring about for grid connected loads. For off-grid applications in particular measures to reduce the price of small-scale renewable energy (micro wind, hydro, biogas, solar PV etc.) can have a profoundly positive effect on rural energy access and poverty alleviation and therefore needs urgent consideration in Pakistan where the potential for such technologies is extremely high yet underdeveloped.

## 3. Barriers and Key Issues in Promoting EE&EC in Pakistan

It is clear from the preceding description that Pakistan is still a long way from mainstreaming EE&EC into its economy, despite several attempts to do so over the past several decades. An examination of these initiatives and their outcomes reveal several impediments that have prevented even the most concerted and well-conceived of these efforts to fail in achieving sustainable, long-term energy savings. Where deliberate, programmatic government and donor-supported actions have foundered however, commercial and market-based drivers (i.e rising energy prices, availability of supplies, technological improvements, etc) have inadvertently been more successful in affecting fuel switching and end-use changes that have significantly impacted energy demand patterns in the country. These include for instance, a substantial conversion of vehicles to CNG use widespread use of roof insulation materials in new building construction, significant increase in market share of more efficient split-type air conditioners in place of package type window units, a steady displacement of incandescent lighting by compact fluorescent lamps and arguably more prudent use of household energy brought about by increased utility retail tariffs. The impact of these market-driven improvements in energy use in Pakistan have of course been swamped by the overall growth in energy consumption brought about by increasing incomes, population and access to modern energy supplies.

On a per capita basis, while energy intensity in Pakistan remains high relative to comparable economies, it has nevertheless been gradually declining (at an average rate of slightly over 4% per annum) over the last decade (ENERCON). The essential need is to find ways of accelerating this trend by:

- Removing the institutional bottlenecks that have previously prevented government sponsored EE&EC programmes and support mechanisms from playing a more effective role in encouraging and nurturing a nascent EE&EC industry and consumer culture
- Further exploiting the commercial and economic drivers for EE implementation by facilitating and promoting the local EE&EC market and removing impediments and disincentives for corporate and end-user EE&EC investments.

This section will outline the main barriers that stand in the way of implementing these strategies based on the previous experience and current status of EE&EC initiatives in Pakistan. There are basically four categories of barriers to EE&EC:

- Management
- Knowledge/information
- Financing
- Policy

Possible solutions to overcome barriers and the stakeholders who need to be involved in implementing these solutions are identified and summarized in Table 11;

## Table: 11 Management Barrier Chart

| KEY BARRIERS | SOLUTIONS | STAKEHOLDERS |
|---|---|---|
| **MANAGEMENT**<br>Lack of awareness at company top management level of EE. This is the root cause of many other barriers, especially:<br>• Management finds production more important<br>• Management is concerned about investment costs of EE measures<br>• Lack of policies, systems, energy/environment managers within companies<br>• Lack of integration of energy into core business management and reporting | • Awareness raising / marketing strategy aimed at company top management<br>• Awareness raising seminars for top management<br>• Training / capacity building of energy managers and external facilitators on how to convince and assist management<br>• Information dissemination<br>• Demonstration projects<br>• Comparative study (benchmarking)<br>• Clearing house<br>• Awards & recognition<br>• Networks<br>• Success stories / best practice examples<br>• Energy labeling of technologies<br>• Media campaign<br>• Inclusion in school curriculum | Everyone influencing company management:<br>International, organizations, government ESCOs, financial institutions,<br>NGOs, Academia<br>Suppliers, customers, Industry associations<br>Media<br>Employees, environmental managers<br>Business management schools & consultants (not just technical)<br>Schools |
| **KNOWLEDGE**<br>• Limited access to and availability of technical information<br>• Limited technical knowledge at company level and facilitating organizations | Strategy that aligns demand and supply of information / technology aimed at company staff and external facilitators<br>.Training/ demonstration on EE technologies, EMS, and CP audits, technology requirements & feasibility studies<br>.Establish systems to maintain knowledge within companies<br>.Customize information and technologies Research & development<br>.Visits to different companies by external facilitators<br>.Comparative studies<br>Technical training /capacity building of energy managers and external auditors and facilitators | • International / Government agencies<br>• Research institutions / universities, ESCOs<br>• Industry / trade associations<br>• Suppliers |

| KEY BARRIERS | SOLUTIONS | STAKEHOLDERS |
|---|---|---|
| **FINANCING**<br>Difficulty in obtaining external financing for EE projects, in particular by SMEs | Financing strategy aimed especially at financial institutions<br>Assist companies to make proposals bankable<br>Different criteria for evaluating / investing in EE projects<br>Special funds & CDM<br>Awareness raising of financial institutions<br>Inform companies about existing financing packages / institutions | Financial institutions<br>Central Bank<br>Government<br>International orgs (e.g. related to CDM)<br>Company finance managers (CFO, accountants)<br>Financial consultants / accountants |

| | | |
|---|---|---|
| **POLICY**<br>• Weak legislation and/or enforcement<br>• Limited financial incentives by government for EE<br>• Irrational (subsidized) energy pricing policies | Policy & legislative reform strategy aimed at government<br>• Resource pricing<br>• Transparency of energy prices, policy, and investments, contracts<br>• Fiscal / economic policies aimed at aligning energy, environment and economic policies and removal of energy subsidies<br>• Pragmatic legislation (something than can actually be implemented & enforced)<br>• Enforcement strategies<br>• Monitoring of compliance<br>• Capacity building of government officials<br>• Change of political will / leadership | • Government<br>• Policy makers<br>• Lobbyists<br>• International community<br>• Service providers (e.g. QMS)<br>• Public / community<br>• Consultants<br>• Industry associations<br>• Financial institutions<br>• NGOs<br>• Employees |

### 3.1 Lack of Money Investment

The most common barrier mentioned is lack of money to invest in. Options with a payback period of more than two or three years were rarely implemented. Some options provide huge savings and a short payback period of often less than one year, but the option requires high investment but do not have the money at hand. One option is to take out a loan but interest rates can be high and banks often do not have confidence in the credit worthiness of companies to give them a loan, especially small and medium sized companies (SMEs).

#### 3.1.1 Lack of Policies & Legislation Enforcement

The major problem is weak enforcement of environmental policies and legislation. During interaction meeting a company representative confessed. It is cheaper to bribe the government official than to spend money on complying with permit conditions. It also revealed that stealing electricity from the network is common because no one is there to check. A reason for limited enforcement is that governments allocate insufficient funds for policy implementation and enforcement and local authorities are often hesitant to fine. But most damaging to energy potential are government policies that are only aimed at short-term rapid economic gain and ignore the environmental impacts and therefore are a threat to long-term economic and social development. An important cause is that many government agencies have an interest in energy but from a different angle.

### 3.2 Pakistan's National Energy Conservation Programme

Pakistan's ability to sustain its current economic growth is strongly linked to its ability to supply adequate energy to various categories of consumers at a reasonable cost. With a population of 160 million and an economy growing at the rate 5.2% GDP growth over the last five year, keeping up with the galloping energy demand is a Herculean task. Indeed, Pakistan's energy supplies have not been able to keep up with rising demands. Over the past few years, peak electricity demand has exceeded peak supply by approximately 25%, necessitating load shedding of more than approx 2500-3000 MW. The cost to the country from both scheduled and unscheduled outages have been estimated to be a reduction in annual GDP of 1.8%. Within the industrial sector, the reduction in value added was estimated at 8.2%. In addition, power

shortages were estimated to reduce the national export of manufactured goods by 7.2% resulting in a loss of foreign exchange of $675 million (ENERCON).

Thus, the inabilities of Pakistan's traditional energy supplies to keep pace with demand are placing a serious constraint on the national economy. Prospects for closing the supply/demand gap in the immediate future are compounded by the following issues:

- Demand will continue to surge due to an aggressive rural electrification programme launched by the government. In addition, domestic electricity demand has been rising at an average annual rate of 16.8% for the past 15 years
- The shift from non-commercial to commercial energy sources will continue with non-commercial energy supplies dropping from 31.8% at present to 26.8% of total supply over the next few years
- Oil imports will increase from 78% at present to 80% over the next five years, in spite of an increase in oil production of 50% over the same period

### 3.3 Performance Indicators and Analysis

The Government is struggling to resolve the energy crisis. Ad hoc measures are being taken with no immediate avail while more shortages loom in an already overstretched energy system. Pakistan's economy continues to grow and industrialize and standards of living improve. Coupled with rapid population growth these factors are causing a steep increase in energy demand. EE is identified as the least cost short to medium term development solution to addressing energy shortfalls. Under the Energy Efficiency Initiative, a diagnostics assessment of the EE sector in Pakistan found that it has a large un-tapped EE market. The past efforts to main stream and implement EE projects in Pakistan failed due to lack of sustainable financing and strategic policy planning. The diagnostics assessment identified the un-availability of sustainable financing as a key barrier to achieving EE benefits in the past in Pakistan. The Government is keen to implement a comprehensive EE investment programme and is looking for a flexible public sector financing mechanism to:

- Scale up the deployment of proven EE technologies in energy supply and use
- Establish a dynamic EE market

### 3.4 Rationale

Improving EE and energy productivity are key components of Pakistan's energy strategy. Reducing un-productive and volatile demand will result in immediate energy savings. Lower energy intensity will boost energy access and meet social development goals and reduce carbon emissions and meet climate change targets. Energy productive Pakistan will be more competitive in the global economy. Pakistan is determined to pursue a sustained long term plan to optimize the energy mix and consumption across all sectors of the economy.

Overall energy savings potential in the country in FY-2008-09 was estimated at 8.4 MTOE (371,400 TJ). These savings correspond to 14.9% of the primary energy demand of 56.3 MTOE (2,489,200 TJ). Savings in electricity in FY-2020 corresponds to a generation

capacity of 3,710 MW. In addition the natural gas saved could be utilized to fuel a power generation capacity of 3,060 MW. The corresponding reduction in annual fuel imports are estimated at 51%. A ten years investment programme, starting in FY-2010 and is estimated at $8.16 billion. This will result in energy savings of 52.11 MTOE (2303,434 TJ) over this period, with many savings continuing beyond FY-2019 (Energy Book-2009).

## 3.5 Strategic Context

A successful long term national EE programme requires:

- Comprehensive policy and regulatory framework
- An integration of EE in all levels of national planning and public investments
- Energy price and utility rate setting reforms and incentives
- A strong equipment standards, certification and testing regime

EE improvement has been identified as a key intervention area in Pakistan Country Strategy. The strategy recommends careful prioritization of new public sector investments with an emphasis on creating a favorable business environment. Priority areas include

- Increasing EE (both supply and demand)
- Optimizing hydropower and support for public private partnerships in hydropower generation
- Balanced energy generation, transmission and distribution
- Sector restructuring, rationalization of tariffs and greater private sector participation

### 3.5.1 Policy Framework

The Government of Pakistan has established a policy framework for EE. Achieving energy security and energy affordability are two main goals set in the Government's Vision 2030 and the Medium-Term Development Framework (MTDF). The National Energy Conservation Policy was adopted in 2006, which defines national EE objectives and broad cross sector implementation parameters. Implementation has been slow, due to limited capacity and financial resources.

### 3.5.2 Sector Roadmap

To achieve the goals defined in these policies, the Government has adopted the EE Sector Roadmap (2010-2019). This Roadmap will be an integral component of the Government's integrated energy planning and will help resolve the current energy crisis, particularly by improving the supply of electricity and gas. The roadmap comprises of a series of correlated regulatory and institutional measures and capital investments. It also defines the overall approach, elements, impacts, responsible parties and timelines necessary to improve energy productivity in the country.

## 3.6 Sector Investment Plan

EE investment requirements for Pakistan over the ten year period from 2010-2019 are estimated at $8.16 billion study conducted by ADB in conjunction with Pakistan Planning Commission. These can be achieved through implementing EE improvement

projects assuming that no external barriers to such actions in the form of financing, information and technology access, policy and pricing disincentives and other such constraints exist.

Details of the proposed EE investment plan are based on realizable potential for energy savings, attractiveness of investments and existing barriers and constraints to EE improvements, the priority areas identified for the ten year investment plan are:

- Energy Efficient lighting and replacement of gas and electrical appliances in the domestic and commercial sectors
- Replacement of existing inefficient thermal power generation units with new higher efficiency configurations
- Replacement of inefficient compressors in the gas transmission systems with high efficiency compressors
- EE upgrades in the industrial sector focusing on the cement, pulp and paper, sugar and textile industries.

### 3.7 Analysis of Key Problems, Opportunities and Solutions

One of the key challenges facing Pakistan is the current energy crisis which is intense costly and multi-dimensional. Pakistan's primary energy supply during FY-2008-09 was 37.3 MTOE consisting of natural gas (32.3%), oil (35.3%), Hydro power (30.3%), coal (0.1%) and nuclear (2.0%). Based on an expected GDP growth rate of 3.5% - 5%, the total energy demand is expected to increase to 122 MTOE in the next 15 years. Given the current constraints in developing the indigenous energy resource base and losses in the power generation and transmission systems, the country will have to face an unprecedented dependence on energy imports. Assuming a crude oil price of US$ 75 per bbl, the annual energy import bill of the country will exceed US$ 41 billion compared to current level of about US$ 7.5 billion in FY- 2009.

Production of natural gas in the country has peaked at 4,000 MMscfd compared to a demand of 4,500 MMscfd. The country faced gas shortages during the winter months supply to the industries has been cut to meet the demand from the households. The installed power generation capacity is 19,620 MW for a population of 160 million. However only 14,000 MW of firm capacity was available in 2009 due to a low level of reliability in the generation capacity and the financial crisis faced by the power sector. The shortfall in electricity supply has resulted in rationing of power in the peak demand periods. The rationing is expected to persist in the coming years as planned capacity additions will fail short of the increase in demand for electricity.

Pakistan is responding to its energy development challenge by pursuing a wide range of options. These include import of natural gas as LNG through pipeline, import of power from Central Asia and Iran construction of large scale Hydro power projects and development of Thar coal reserves. A number of Independent Power Projects (IPPs) projects have been contracted and are in different stages of development. The

Government has also formulated a new policy to encourage investment in oil and gas exploration. Renewable energy projects are being promoted with a target of 10% of energy mix to be met from renewable sources by 2015.

Compared to the supply side options, EE offers Pakistan a least cost alternative for augmenting and maximizing the utility of the energy resource base of the country. Energy Efficiency and Conservation is therefore emerging as a priority in government's energy policy to address the current energy crisis in a sustainable manner. Additional benefits of EE include reduced expenditure on energy for the end users environmental impacts and carbon emissions raise economic productivity and accelerate social development create significant new job opportunities result in better resource utilization, improve returns on infrastructure investments and help integrate Pakistan better into the global economy as it grows along a more sustainable development path.

The households in Pakistan accounted for about 21.7% of total electricity consumption in 2009. Lighting is the main driver of the peak load in this sector. Efficient lighting can reduce the demand for electricity by around 40% and replacement of incandescent bulbs with compact fluorescent lamps (CFLs) can save about 1,600 MW of the peak demand. Retrofits of existing space and water heaters and purchase by households of energy efficient appliances could be financed by the gas utilities through loans to residential gas consumers re-paid on their utility bills in affordable installments. In addition, standards and regulations promoting efficient appliances would be required as well as a programme to improve the efficiency of domestically manufactured gas appliances. The Government has a Power Distribution Sector Roadmap and a Power Transmission Sector Roadmap to improve efficiency and cut down losses in these sectors.

### 3.7.1 External Assistance to the Sector

The major sources of external assistance to the energy sector are ADB, Japan and the World Bank. These three partners together have provided more than half of the official external assistance. The assistance from ADB has been directed to KESC, WAPDA, PEPCO, NTDC, DISCOs and gas sector restructuring. The World Bank mainly provided assistance to WAPDA and PEPCO as well as support for generation of power from coal. Japan has provided major support for investment projects in the power sector. The key policy thrust persuaded by all three major development partners individually has been to evolve a strategy for the privatization of the power sector. For example, ADB supported the privatization of KESC and both ADB and World Bank Group through their private sector arms provided debt financing to the privatized KESC. The policy matrix prepared for the reform programme in the sector has been a joint effort of the ADB, World Bank and the Government in consultation with stakeholders and other development partners with clear delineation of the division of labor between the two multilateral institutions. European investment Bank is a co-financing partnership with ADB & assisting Government for renewable energy investment. Recently, the Islamic

Development Bank is under discussion with the Government to support augmentation of Rawat Grid Station and assistance for three small hydropower projects in Northern Pakistan. In terms of bilateral support, the Canadian International Development Agency (CIDA) has supported WAPDA to rehabilitate the Warsak Hydroelectric Power Station and development of national power plan. It has also provided assistance to strengthen the capacity of the Ministry of Petroleum and Natural Resources to develop and implement sound policies and regulatory frameworks to encourage private sector investment and to enforce effective conservation and environmental regulations. CIDA also supports public and private companies to develop and manage hydrocarbon resources. The Government of France has provided support for development of mini Hydro power plants in the Khyber Pukhtunkhwa and Gilgit Bultistan of Pakistan. The Government of Germany is also supporting a hydropower promotion programme and a grid station in Ghakkar for power transmission from Ghazi-Barotha. It is also financing hydropower feasibility studies and hydropower projects development as well as technical support for policy development and pilot programmes in renewable energy and EE with the Alternate Energy Development Board and the National Energy Conservation Center. The Government of Japan is supporting upgrade of load dispatch system at the National Power Control Center, as well as investments in transmission and distribution system. It is also extending technical cooperation for grid system operation and maintenance system improvement. Expected assistance for rehabilitation of thermal power plants in Jamshoro and Muzaffargarh is also in the pipeline. The Government of Netherlands is extending support for a cleaner production programme with the industrial sector and compliance with National Environmental Quality Standards (NEQS) and EE. USAID has a planned assistance pipeline for energy policy and pricing, Energy Efficiency and Conservation and capacity building of energy sector line agencies. The ADB has been the major source of external assistance to the energy sector in Pakistan having provided about one-third of total external resources to the sector. ADB's non-lending activities have also been important in the sector with a total of $18.6 million provided for projects. Since 1968, total lending to the energy sector in Pakistan amounts to about $4.2 billion of which $3.6 billion is to the power sub sector and $0.6 billion to the natural gas and petroleum sub sectors. Since 2006, ADB's overall lending to the energy sector accounted for about 32% of total lending to Pakistan. About three-fourths of the assistance to the power sub sector ($2.2 billion for 15 loans) has been provided to WAPDA (and its unbundled entities), $150 million to provincial power departments and the rest to KESC.

### 3.7.2 Sector Portfolio Description

The energy sector portfolio currently has three MFFs ($2.1 billion) and two ongoing projects, amounting to $2.4 million. The main areas covered include tariff rationalization and integration, management information systems, power generation coordination, thermal power plant maintenance, institutional strengthening and

restructuring, and privatization.

### 3.7.3 Key Sector Portfolio Performance

The Country Assistance Programme Evaluation (CAPE) rated ADB's interventions in the energy sector as "successful" noting that the overall success rate of energy sector projects during 1985-2007 was a high 81%. The success rate for projects approved in the 1990s was however, much lower at 50%.

### 3.7.4 Impact and Outcome

The proposed Investment Programme will help realize EE benefits in critical energy consuming sectors and create a dynamic institutional and business environment for further EE investments. It will improve Pakistan's energy security by balancing energy demand and supply improving use of available resources and optimizing the energy mix by reducing oil imports.

**Outputs**

Increased investments and market penetration of energy efficient technologies as a result of the proposed Investment Programme would bring about:

- Reduced electricity use in the industrial, residential and public sectors amounting to 2,880 GWh per year
- Reduced energy transformation losses in the gas transmission and thermal power generation sectors totaling 601,670 tonnes of oil equivalent (TOE) or 26,595 tera joules (TJ) per year
- Reduced gas, oil and coal use in the residential and industrial amounting to 896,870 TOE (39,643 TJ) per year
- Establishment of National Energy Efficiency standards, testing and certification regime
- EE mainstreamed into planning, investments and managed effectively under strengthened policy, legal and regulatory frameworks and institutional capacities
- Reduced air pollution and greenhouse gas emissions from environment

## 3.8 Technical Justification

Substantial energy savings can be achieved in the country through investments in EE projects. The principal energy consuming sectors and their shares of total consumption in 2009 were industry (39.8%) transportation (30.5%) domestic (21.7%) and others (4.2%). Estimates for achievable energy savings were developed on the basis of the technical potential and the extent to which this potential can be realized over a ten-year period taking into account existing barriers and constraints to implementation. The annual energy savings potential in Pakistan is currently estimated at 6.07 million tonnes of oil equivalent (MTOE) or 268,400 TJ, which corresponds to 15.4% of the total energy consumed in FY-2009.

Based on the assessment of realizable potential for energy savings financial and economic viability and existing institutional barriers and constraints, the proposed Investment Programme will target two priority areas:

- Demand side reduced energy waste in the domestic, industrial and public sectors
- Supply and transformation side reduced energy losses in thermal power generation and gas transmission

### 3.9 EE Sector Investment Plan

The total investment requirement for the EE sector from FY2010-2019 is estimated at $8.16 billion.

**Table no: 12 Energy Efficiency Investment Plan**

| | FY10 | FY11 | FY12 | FY13 | FY14 | FY15 | FY16 | FY17 | FY18 | FY19 |
|---|---|---|---|---|---|---|---|---|---|---|
| Domestic | .18 | 37 | | 329 | 384 | 384. | | | | |
| Commercial | | 1 | 5 | 15 | 24 | 22 | 11 | 3 | 1 | |
| Industrial | | 22 | 134 | 403 | 650 | 605 | 314 | 90 | 22 | |
| Agriculture | | 5 | 28 | 85 | 137 | 127 | 66 | 19 | 5 | |
| Transportation | - | 7 | 41 | 123 | 199 | 185 | 96 | 27 | 7 | |
| Oil Refining | | 1 | 5 | 15 | 23 | 22 | 11 | 3 | 1 | |
| GENCO Replacements | | 151 | 205 | 129 | 52 | 305 | 572 | 946 | 664 | 260 |
| Generation at Decompression Sites | - | 0 | 2 | 6 | 10 | 10 | **5** | 1 | 0 | |
| Gas Compression | 16 | 42 | 44 | 28 | | | | | | |
| **Total** | **34** | **266** | **464** | 1,133 | 1,479 | **1,660** | 1,075 | **1,089** | **700** | **260** |
| Cumulative | **34** | **300** | **764** | 1,897 | **3,376** | **5,035** | 6,110 | 7,200 | **7,900** | 8,161 |

Source: Pakistan Energy Yearbook, 2009 and PPTA consultants

For the GENCOs and Gas Company investments, it is expected that at least 20% of the investment will come through internally generated funds or equity and 80% from financiers. The private sector (domestic, industrial, agricultural, transportation, oil refining) is expected to finance 45% and borrow commercially for 55% of the investment. The Government is actively looking for funding from the private sector and other agencies. Agence Francaise de Developpement (AFD) is expected to co-finance EURO 150 million. ADB's proposed multitranche financing facility (MFF) will act as the anchor for the investment plan and act as front-runner for commercial investments.

**Table: 13 Financing Plan, ($ million)**

| **Total Programme** | Investment Projects | | **Programme Support** | |
|---|---|---|---|---|
| | Amount | Share | Amount | **Share** |
| Government of Pakistan | 650 | 8% | 17 | 20% |
| Asian Development Bank | 760 | 9% | 20 | 23% |
| Agence Francaise de Developpement (EUR 150 million) | 180 | 2% | | |
| Other Financiers | 1.858 | 23% | 50 | 57% |
| Private | 2,120 | 26% | | |
| Commercial Borrowing | 2,592 | 32% | | |
| **Total** | 8,161 | 100% | 87 | 100% |

Source: ADB, PPTA Consultants

The Investment Programme cost (physical and non-physical) is estimated at $1,192 million including taxes and duties. The total cost includes physical and price contingencies and interest and other charges during implementation.

**Table: 14 Tentative Investment Programme**

| Item | | Amount ($ million) |
|---|---|---|
| **A.** | **Physical** | |
| | 1. T-1: National CFL Distribution | 102.00 |
| | 2. T-2: Gas Compressor Upgrade | 130.00 |
| | 3. T-3: Thermal Power Plant Loss Reduction | 545.00 |
| | 4. T-4: Government Buildings Lighting Retrofit | 60.00 |
| | 5. T-5: Domestic Appliance Replacement | 80.00 |
| | 6. T-6: Industrial EE Financing Facility | 250.00 |
| **B.** | **Non Physical** | |
| | 1. Support Component | 25.00 |
| | **Total (A+B)** | **1,192.00** |

Source: ADB, PPTA Consultants

### 3.10 Institutional Bottlenecks

The greatest single barrier to implementing an effective programmatic EE&EC strategy in Pakistan has been the weak institutional underpinnings of such an approach in the past, emanating from an indifferent long-term government commitment to EE&EC goals and the failure to include them meaningfully in national economic planning. This in turn, has precluded a strong institutional leadership for EE&EC within the Government from developing, while preventing intermittent donor support in the area from coalescing into a cohesive and sustained capacity and market development initiative which could eventually induce and foster full scale private sector participation. As a result, the economy in general and the government machinery in particular has not been re-oriented in a discernable manner to integrate EE&EC into its broader functioning. The specific institutional shortcomings that need to be addressed in the future for overcoming such shortcomings in institutional EE&EC support are discussed below.

#### 3.10.1 Government Commitment

As in many other countries undertaking initial steps towards introducing EE on a national scale, government commitment to the cause in Pakistan has been sporadic, predicated largely by short-term economic necessity (fuel or power shortages, oil price escalation, etc.) rather than as a long-term planning goal. However, given that one of the pioneering national EE&EC programmes amongst developing countries was undertaken by Pakistan beginning in the 1980s, the lack of meaningful progress subsequently in this respect should be of particular concern highlighted not only by many other less advanced economies that have overtaken Pakistan in terms of national EE indicators, but also the sharp reduction in the Government's own current institutional EE&EC capacity and spending compared to the peaks achieved under donor-assisted programmes in the past.

Meaningful political support to a national EE&EC initiative can only be assured if EE is

accepted by the country's economic planners not just as a useful energy management option to be resorted to whatever extent possible, when supply shortfalls loom or fuel prices surge, but as an economic goal in itself by targeting specific time bound reduction in national energy intensity in order to obtain maximum socio-economic benefits for its citizens as well as for making its industry competitive in the global marketplace.

This would require several conceptual changes in the Government's planning process that would include:

- Embedding EE&EC in the national energy policy and security strategy as a targeted supply option by identifying realizable energy use improvements in key consumption sectors of the economy.
- Evaluating available options and the actions and means required for achieving such EE&EC improvements according to a phased sequential action plan which includes performance benchmarking, institutional monitoring and verifiable programme milestones.
- Devising an effective EE&EC institutional, policy, legal and regulatory framework that can facilitate the implementation of a coherent, long-term national EE&EC action plan in both public and private sectors including proper provisioning of financial, manpower and technical resources.
- Reorienting government planning and spending in all sectors so that EE&EC considerations and requirements are met across the board by all agencies as part of their routine operations, planning, investments, service provision and infrastructure development activities.
- Coordinating government and donor actions, policies and planning to help sustain and build upon successive EE&EC gains over the long term to help redirect national economic growth on a more energy efficient footing.

The importance of these measures cannot be understated as the extent to which they are implemented would determine the longevity and extent of national cumulative energy savings in the long run. As such, the implications of each of these requirements would need to be examined in detail and understood properly before designing a future EE&EC strategy that does not follow the fate of previous efforts.

### 3.10.2 Planning and Coordination

Thoughtful planning of a revised national EE&EC initiative is required if previous mistakes are to be avoided. Well designed and sufficiently detailed planning would take into account past experience and local conditions, especially implementation and capacity constraints amongst potential stakeholders, as well as current conditions and emerging market opportunities in four key aspects:

- Market and economic evaluation of significant cost-effective EE&EC opportunities in key sectors, prioritization and sequencing of action areas, and

definition of realistic national EE targets

- A review of the strategic approach to EE&EC implementation with well-defined stakeholder and institutional roles (including leadership responsibilities), focus areas, tasks, outputs, organizational setup, coordination and networking arrangements and reporting requirements
- An evaluation of the technical, material, financial, manpower and other resources required and their respective sources for meeting the investment and recurring costs of a sustained long-term EE&EC strategy and necessary allocation and procurement of commitments from stakeholders.
- Establishment of effective institutional and national EE&EC performance data collection and monitoring mechanisms in the form of measurable milestones information sharing institutional and programme evaluation end-user and market feedback etc that allow for corrective actions and mid-course refinement to be undertaken promptly.

### 3.10.3 Organizational Roles

There are two aspects to the organizational setup relevant to a national EE&EC initiative:

- The larger context of the energy sector supplier, consumer and management structure as well as the state of the domestic energy market
- The specific institutions tasked with or otherwise directly engaged in EE&EC promotion, facilitation and implementation

As far as the first category is concerned the ongoing deregulation, privatization and corporatization of the previously monopolistic, state-run energy supply and distribution system in Pakistan offers new opportunities and challenges for implementing effective EE&EC practices. On the one hand, introducing market competitiveness, removing price subsidies, and penalizing inefficient operations raise the economic and financial imperatives among market stakeholders for adopting improved EE&EC measures, while on the other hand un-bundling erstwhile monolithic energy utilities into for instance, separate production, transmission and distribution entities complicates the situation for external programmatic interventions that are also simultaneously required in a 'push-pull' EE&EC strategy, such as those necessary for implementing DSM measures. This is because in a disaggregated and decentralized organizational scheme, the investor and beneficiary of EE&EC implementation are often separate and distinct entities. For example, savings or changes at the consumer level would not automatically impact energy supply as they would under an integrated energy supply scheme (the so-called 'split incentive' barrier). In this case, a differentiated strategy might be required. DSM as a tool to displace peak demand and consequently lower demand periods would make sense for DISCOs, while energy savings at a lower than production marginal cost would appeal to integrated power companies and society in general, as it would contribute to least-cost power supply. Nonetheless, overall market liberalization, tariff rationalization and increased consumer

choice is universally accepted to provide along with other benefits improved prospects for higher EE despite the correspondingly more sophisticated market sensitive EE&EC approaches required in such instances.

In the more narrow sense of actual EE&EC delivery, especially with respect to ownership and implementation of a national EE&EC agenda, poorly defined institutional roles and capacity shortfalls have been particularly relevant to Pakistan's failure in consolidating upon promising initiatives in the past. In this respect, ENERCON's variable record, management and inability to mobilize and coordinate a coherent and sustained role for itself has been discussed previously. In addition to evaluating ways of strengthening its institutional capacity to play an important role in a revised national EE&EC agenda, the rationale of ascribing an encompassing mandate to a central organization, no matter how well endowed is also questionable in other words an effective role for ENERCON should be redefined (instead of simply focusing on revitalizing it as the sole national EE&EC gatekeeper) adopting a realistic view of both attainable capacity levels as well as the inherent need for a much broader stakeholder participation in actual EE&EC implementation in the future.

Effective national EE&EC management involving a host of disparate energy sector stakeholders' interests and consumer groups may well require a broader base of more dispersed institutional structure and agency instead of compartmentalizing it into an isolated federal agency as per past practice. Certain functions such as, information collation and dissemination, donor coordination, service and product certification, technical training and interagency liaison among others would best be centrally coordinated and administered. However, wider institutional involvement in actual EE&EC dissemination, implementation, financing and servicing may well require greater direct localized government utility, industry, trade and consumer group involvement. This approach would not only enable distinct institutional strengths and relevant commercial interests to be better leveraged for specific EE&EC purposes (e.g utility-led DSM programmes, industry-led audit programmes, municipal building energy and street lighting standards etc) but would also greatly reduce the strain and dilution of functions amongst central agencies such as ENERCON that could instead better focus on their primary coordination and facilitative roles. In addition to a horizontal broadening of the EE&EC institutional setup, the development and expansion of individual organizational mandates should initially focus on priority functions only gradually expanding over time as both institutional and market capacities develop and mature in line with a phased EE&EC implementation plan.

### 3.10.4 Staffing and Resource Allocation

Lack of sufficient political commitment or clear long-term goals results not only in vaguely defined and over ambitious mandates being ascribed to nascent institutions such as ENERCON at the time of their inception, but also result in inadequate funding and resource allocation to them subsequently. ENERCON in particular, has suffered from chronic resource shortages, protracted management changes and has been buffeted by bureaucratic interference being shunted from one parent ministry to another since the end of USAID assistance. It presently resides, improbably at the

Ministry of Environment, where it has often been side tracked into tangential activities such as RE and GHG mitigation. Faced with persistent funding shortages and shackled by staffing constraints, it has since relied instead on donor-assisted projects for technical, managerial, and financial resources. Such a state of affairs not only precludes any meaningful institutional development or service delivery over time, but greatly de-motivates existing staff and makes it virtually impossible to attract additional qualified personnel, as has been evident in this case. Apart from a re-assessment of the required institutional setup with more realistic and workable mandates for institutions such as ENERCON, a future Government EE&EC initiative must therefore clearly strive to empower these agencies with the necessary political and functional powers adequate minimum upfront and recurring budgetary support guarantees and administrative independence to be able to recruit and retain the best available expertise over the long term. Funding, staff and material resources must be properly assessed as part of the institutional reorganization activity at the outset in line with the development of the national EE&EC policy and action plan.

### 3.11 Management and Monitoring

Finally, weak organizational management and institutional monitoring has often been the Achilles heel of several Government attempts at creating new agencies. New institutions in particular require a great deal of additional effort in defining and organizing their internal affairs and operations, properly developing new management systems, and building capacity while having to learn their main tasks and functions at the same time. That the latter is frequently overstated at the outset instead of being expanded gradually from a modest, initial mandate as the institution learns to stand on its feet often completely overwhelms and derails the effort with the agency invariably resorting to surviving 'on paper' rather than in terms of actual capacity to deliver. This situation usually remains un-remedied, especially given the lack of established agency performance monitoring mechanisms within the Government administrative framework and assumes the shape of an entrenched institutional characteristic that becomes extremely difficult to change in the long run. At the same time, dedicating a complex task to a single-purpose made agency conveniently compartmentalizes the issue and absolves decision makers of further responsibility and additional efforts in this respect are either not taken or re-directed to the agency that has little capacity to implement them, thus wasting money as well as losing time constrained opportunities for affecting meaningful change.

This situation can easily be rectified if line agencies, such as ENERCON or any other organization created with a specific mandate on EE&EC, are given along with the necessary resources and technical assistance clearly defined organizational roles, annual plans and targets with mandatory reporting requirements that can be reviewed periodically at the appropriate executive levels and can provide the basis for both corrective action as well as subsequent institutional enhancement and expansion. Such monitoring must extend to key personnel outputs, activities, financial management and external stakeholder feedback and can be utilized as an evaluation and motivational tool for staff and management. Such a system alone, if reasonably designed could bring about a sea change in organizations that otherwise find it impossible to boot strap from the ad hoc

and isolated circumstances in which they usually find themselves.

In addition to institutional and organizational monitoring mechanisms, an effective EE&EC programme must be based on measurable national targets and intermediate milestones. The success of programme design, the need for mid-term modifications, the allocation of additional resources, and the expansion of the programme's ambit all depend critically on a proper evaluation of the results achieved against a scale of benchmarks derived from local and international experience. This in turn, requires a strengthening of relevant energy-related data collection and analysis capabilities which must be properly institutionalized within the new EE&EC organizational arrangements.

### 3.12 Market Barriers

Typical examples of barriers to the commercial viability of EE&EC investments in the marketplace include:

- Lack of information, knowledge and experience amongst residential, commercial, industrial, low-income and small business energy consumers on the costs, benefits and effective approaches 'best practices' for securing EE
- Utility incentive structures that associate financial performance to energy sales
- Lack of standard methods for incorporating EE&EC in business planning in industry and commercial sectors as a potentially key competitive resource
- Ratepayer tariffs and prices that do not reflect the full costs of providing supplies, thereby 'undervaluing' energy use.

#### 3.12.1 Awareness and Technical Know-how

Even though investing in EE is economically sound there remain strong barriers to its implementation awareness being a major one. EE however, is a concern for several public organizations. Separate seminars have been organized by various entities (NEPRA, ENERCON and SARI), shopping list of EE measures have been prepared by the Energy Wing, DISCOs, NEPRA. Much of these efforts are made without taking advantage of the 30 years of international experience in designing EE policies and programmes.

At the market level as noted earlier, EE in Pakistan has been almost exclusively promoted by equipment suppliers that have more efficient equipment to sell compared to their competitors. This has meant that only a limited range of energy users could be reached by such technologies. In the meantime, poor efficiency, cheaper equipment has also been spreading in a growing and more competitive market on account of lower purchase costs.

Professionals providing services to industry and building managers are not compensating for this lack of proper EE&EC promotion. Architects interviewed for this study clearly mentioned that they were almost never asked to explore energy efficient solutions in their designs, both commercial and residential and that they generally comply with their clients requirements rather than proposing long-term energy saving solutions at higher up-front construction costs. Moreover, most were unaware of ENERCON's Building Energy Code or its current revision. It would perhaps not be inaccurate to state that despite over 15 years of the code's existence not a single building in Pakistan has been designed to be fully compliant with its recommendations.

Availability and access to relevant data is usually another impediment to EE&EC implementation. A thorough analysis of the national energy market (where and why energy is used, in what form, what quantities, etc) is a pre-requisite to designing any sustained EE effort. Conducting a statistical analysis for the supply side of the energy equation has become routine in many countries, while EE by contrast generally suffers from a lack of detailed demand side end-use data that would provide a detailed view at the national level and would enable policy makers or market actors to make informed decisions to choose a more energy efficient path. This dimension requires efforts on data collection by dis-aggregated consuming sector and end-users, an understanding of consumer behavior and technology in a given energy service (i.e realistic EE&EC penetration potential) and the consequent development of EE indicators and targets. EE cannot be promoted successfully in the industrial sector for instance, without a sound energy audit of existing installations and assessment of upgrade options available to each type of facility.

Energy efficient behavior of consumers requires broad-based and persistent education and information dissemination. Several European countries are experimenting with so-called 'social marketing' approaches to enhance energy efficient consumer behavior and support DSM concepts. Social marketing is planning and implementation of programmes designed to bring about social change and to influence individual’s behavior using concepts from commercial marketing. While commercial marketing usually urges an exchange of money for goods or services, social marketers usually ask an audience to change its practices in return for something of value. The central challenge of any social marketing programme is to establish which exchange is likely to satisfy both the marketer’s needs as well as the target audience needss in addition to producing an overall societal benefit.

### 3.12.2 Financial, Pricing, and Fiscal Incentives

Higher quality EE&EC equipment is generally more expensive than low efficiency equipment. To overcome this additional cost barrier, EE&EC policies and programmes may contain some financial and or fiscal strategies to facilitate the introduction of more expensive technology into the market and initiate a gradual transformation in the long term as the benefits of such higher up-front investments in the form of life-cycle energy savings become apparent and they become more widely and commonly used in the market.

Pakistan has experienced such price-leveraged EE&EC initiatives in the past. For instance, as a result of ENERCON's advocacy efforts in the 80's, a rebate on customs duties was provided for CFLs over incandescent lamps. Apparently, there was no specific impact analysis undertaken of this measure on the market demand. It can be argued however, that the evident success of CFLs in the Pakistani market is partly due to this fiscal incentive (the other important determinant being the rising ratepayer electricity tariff in the interim). In the federal budget for 2007-08 however, the Government has significantly reduced this fiscal incentive (i.e duties on CFLs were raised from 10% to 15% by value). In terms of EE&EC policy effectiveness, this apparently retrogressive move may not be a counterproductive measure if a market evaluation clearly shows that this rebate is no more required by customers and that the

demand for the product would not be significantly affected by it. It seems however, that this is not the way the decision to remove the fiscal rebate was made nor have that high enough penetration levels of CFLs in the local market been achieved. In all likelihood this revision was made purely for revenue considerations and was not disputed by any entity in the government giving a clear indication that there is no EE&EC relevant monitoring and coordination capability within the Government at present.

### 3.12.3 Regulatory and Legislative Support

In 2007, the Government was preparing a set of immediate measures to regulate electricity use and alleviate the impact on the population of severe power shortages being experienced in the country at that time due to rising peak summer demand levels. It should be clearly mentioned that such short-term, reactionary initiatives should not be identified as an element of or a substitute for a national EE&EC policy. An EE&EC policy is a long term set of guidelines based on data research and strategic approach, with clear objectives and a built-in evaluation process to adjust individual initiatives and parameters, which allows sound and consistent decisions to be made in terms of designing programmes, interventions, pricing, legislation, regulations and other tools for affecting permanent improvement in national EE indicators and practices. The regulatory and legislative support to EE&EC is almost missing from the legal framework in Pakistan. This is a major deficiency for EE&EC promotion in the country and that must be addressed urgently in line with a comprehensive policy development initiative.

### 3.12.4 ESCO Support

The establishment and use of energy service companies (ESCOs) is recommended as one of the best long-term solutions to establishing EE programmes and policies in industry and households, but ESCOs often face significant resistance in the market, at least at the outset. Good information dissemination plays a major role here, unless people and industrial consumers are aware of the economic opportunities of EE, it is hard for them to be stimulated to act or pay for such services. Viable ESCOs as a result of GEF projects have been established in Tunisia and China for instance. Lessons learnt from a GEF co-financed project in Malaysia reveal the problems that ESCOs traditionally face the concept is not as readily accepted in industry compared with ESCOs in the building and commercial sectors (unless the ESCOs are involve in a 'high' value generating capacity, such as turnkey co-generation or power generation projects). Industry owners generally feel that their own engineering staff are equally or more competent than external consultants (i.e ESCOs personnel) and prefer to use their in-house teams at no additional cost. This has been shown to be especially true where the industries involved have significant processing activity involving proprietary methods which are not willingly shared or understood easily and therefore challenge ESCOs in gaining a toehold in the market.

**Policy Recommendations**

- Formulate and enact EC Legislation and Audit Standards at national level.
- Pakistan Energy Conservation Council should be reactivated.

- National Energy Conservation Centre should be strengthened and ENERCON should develop an integrated plan of action in consultation with the key stakeholders, for implementation after the approval of the Council.
- The already approved Building Energy Code of Pakistan should be made a part of the Building Code of Pakistan and its implementation made mandatory.
- In the immediate scenario, the Government must adopt "**the least cost supply option**" as the immediate EC policy. The package should have specific implement able programme with defined implementation schedules and measurable energy savings
- Government has provided liberal incentives to the petroleum sector, the power sector and the industry sector. Government should ensure a level playing field and may permit similar incentives to the conservation industry. The Government should strengthen financial mechanisms, institutions and associated policies and regulations to provide innovative lending specially in the demand side efficiency improvement. Financing sector entities, including development financing institutions dealing with industrial modernization, agriculture, environmental and housing portfolios are targets for such institutional reforms.
- Energy efficient imports should have a preferential status over inefficient imports.
- The energy producing agencies may be asked to announce their plans and targets for conservation on yearly basis.
- Reduce dependence on non-renewable forms of energy by increasing energy generation through renewable forms of energy.

**Strategies/ Actions for EE&EC**

- Encourage ESCOs which are the main drivers of energy conservation in the west
- Re-activate the National Energy Conservation Award
- Initiate Energy Labeling Programme
- Eliminate the flat rate tariff for tube wells
- Permit free trade of electricity for co-generation plants. Alternately, WAPDA/KESC should purchase all electricity generated through co-generation
- Support and encourage efficient alternatives to capacity expansion for utilities through better utilization of existing capacities
- ENERCON along with Electricity / Gas Utilities should develop programmes to educate consumers through media, T.V and Radio Corporations should allocate airtime for consumer education on conservation
- Undertake mandatory EIA of new power plants and monitoring of emissions according to established standards and include energy pricing that reflect "real" cost accounting for adverse impact on the environment
- Develop the National Energy Policy through a consultative process

- Demonstrate country-wide projects/activities for energy conservation, solar thermal technologies, wind mill/generator manufacturing, promotion of micro-Hydro power stations, solar lighting in a village and introduction of solar pumps.

# 4. Roadmap for National EE&EC Implementation

## 4.1 Approach

Based on past national and global experience, a phased strategy for undertaking a systematic broad-based national EE&EC initiative in Pakistan is recommended. This would allow for a revival and enhancement of existing EE&EC capability in the country in the short and medium terms in a sustainable manner, while consolidating and expanding them in the medium to long timeframe. Such a phased approach would call for a series of sequential and overlapping actions that could ultimately be mutually reinforcing and will require strong and unwavering political support and leadership from the Government and the donor community. A broad outline for such a strategy is provided below.

## 4.2 Short Term Strategy

### 4.2.1 Period

- Year 1

### 4.2.2 Objectives

- Provide coherent strategy and action guidelines for initiating a sustainable long term national EE&EC programme.
- Initiate activities leading to the development of a full-scale, national EE&EC initiative.
- Achieve immediate EE&EC improvements by implementing number of low-cost actions, fiscal measures and policy directions and removing obvious anomalies and impediments in this respect to the extent possible.

### 4.2.3 Action Areas

**Preparatory Activities**

- Establish a dedicated high level multi stakeholder EE&EC Working Group for preliminary planning and programme initiation to develop and seek approval for National EE&EC Strategy and Policy Directives that can be implemented with immediate effect and undertake preparatory activities for comprehensive programme development and funding arrangements. It is suggested that the EE&EC Working Group be housed at the Planning Commission which can initially be in charge of overall EE&EC coordination and responsible for ensuring proper stakeholder inputs to the planning process.
- Initiate detailed market potential and barrier analysis, programme design, resource (institutional, technical, manpower, material, and financial) evaluation and effective organizational needs assessment for undertaking phased, prioritized EE&EC interventions in all macroeconomic sectors and involving all stakeholder organizations as well as individual end-user interests (including those of the 'energy poor' and marginalized population segments).

**Immediate Policy/Payback Options**

- Identify and rectify existing policy and regulatory anomalies or provisions impeding EE&EC implementation particularly import duties and sales taxes on EE equipment (e.g

CFL, LED, high pressure sodium, metal halide lighting, variable speed drives, cogeneration systems, power factor correction, capacitors, CNG conversion kits, computerized engine diagnostic and tune-up equipment, energy control and management devices, thermal insulation materials, RE equipment etc) and possible surcharges on trade in inefficient items (e.g incandescent lamps, used/reconditioned vehicles and machinery etc)

- Undertake with government, private and multilateral financing and partnership arrangements, readily implementable EE&EC investments with quick payback that do not depend on extensive policy, institutional or market reforms.
- Demonstrate Government leadership and commitment by initiating mandatory public sector EE&EC practices in new asset acquisitions, construction and use, where possible (e.g roof insulation, CFL replacement, vehicle fleet tune- up & conversion, thermostat set points etc) with appropriate budgetary allocations for estimated annual compliance costs.

### 4.3 Medium Term Strategy

#### 4.3.1 Period

- Years 2-5

#### 4.3.2 Objectives

- A detailed National EE&EC Policy and Action Plan addressing all macroeconomic sectors and stakeholder roles with time bound quantitative and qualitative efficiency targets for energy supply, management and use (i.e National EE&EC Vision)
- Commensurate institutional, technical and management capacity in public and private sector for targeted EE&EC delivery needs with appropriate organizational and programme cross linkages and coordination procedures in place (i.e National EE&EC Partnership)
- Appropriate macroeconomic and institutional EE&EC performance-based evaluation and remediation mechanisms for continual programme monitoring improvement and expansion
- A comprehensive and supportive national EE&EC policy, legislative and regulatory framework that can evolve in accordance with market and technology developments
- EE&EC considerations integrated into mainstream national economic and development planning as well as public sector operations, acquisitions and infrastructure development portfolios
- Provision of easy financing options for EE&EC investments and procurement available to the private sector and individual end-users including ready low-cost loans, fiscal incentives and credits tax exemptions and risk cover guarantees
- Substantially improved market and end-user awareness of and access to EE&EC products and services, energy auditing, technology transfer, ESCO operations, repair and manufacturing capability, standards and certification, crediting and awards etc
- Improved national-level EE&EC awareness, consumer education and operator and

industrial technical know and energy use practices

### 4.3.3 Action Areas

**Market and Economic Assessment**

- Complete EE&EC market, barrier and potential assessment and identify and adopt sector/ market-wise time-bound national EE&EC targets, milestones and monitoring indicators
- Undertake economic and comparative benefit cost analysis of key EE&EC investments in major energy consuming sectors (industry, buildings, transportation, agriculture, commercial and residential) prioritize focus areas & develop realizable quantitative implementation targets, schedules and define verifiable EE indicators and performance monitoring methods
- Undertake energy pricing reforms study to highlight tariff and price distortions and disincentives for EE&EC and evaluate and refine appropriate tax/subsidy, tariffs, structures and price-based incentives/penalties (time-of-day tariffs, power factor penalties, smart subsidies, system benefit charges, rate-basing, shared savings, road use charges etc) for inducing improved energy supply and use practices
- Encourage/task major energy suppliers and end-user groups and organizations e.g industrial sub-sectors moving stock fleet operators city planners and large real estate developers, power and gas utilities, equipment manufacturers, military entities, large commercial malls, hospitals and hotels etc) to evaluate and devise respective sector asset and operation specific EE&EC savings, plans and policy recommendations, providing appropriate technical assistance to designated professionals, institutions and trade bodies for this purpose

**Policy and Programme Design**

- Incorporate preceding analyses and EE&EC Working Group recommendations into a revised, comprehensive ten year National EE&EC Policy and Action Plan and corresponding funding programme including Government donor, private and civil society contributions that fully addresses both supply and demand side efficiency improvement measures
- Initiate design and provision of EE&EC specific institutional, legal, regulatory, market and infrastructure development through programmatic interventions and assistance

**Institutional, Legal, and Regulatory Arrangements**

- Define national regional and sectoral EE&EC management and organizational requirements and develop corresponding institutional management designations mandates structures, work plans, reporting requirements and capacity and resource needs based on clearly defined respective tasks, output and growth plans
- Develop and enact EE&EC specific legislation, regulations and undertake policy rationalization applicable to all major energy uses on both the supply and demand sides
- Incorporate EE&EC in public sector project appraisal criteria by revising Planning

Commission proformas to explicitly ensure that EE evaluation measures incorporated into project design and estimated resulting energy savings over project life are accounted for and harmonize associated guidelines and training needs

- Develop stakeholder coordination and cooperation mechanisms for improved EE&EC programme design, implementation and continuity
- Develop and deploy robust implementation performance and service delivery monitoring verification and evaluation criteria and response systems as a key requirement in every Government and donor led EE&EC agency, institution, project, and programme, including external feedback and remediation provisions.
- Develop national equipment EE standards, testing and performance certification requirements for major energy consuming equipment and assets

**Market Facilitation and Support Infrastructure**

- Initiate equipment energy performance standards, certification, labeling and compliance requirements for the following consumer products:
    - ❖ Packaged and split-type air conditioners
    - ❖ Refrigerators and freezers
    - ❖ Compact fluorescent lamps
    - ❖ Natural gas/LPG-fueled space/water heaters and cook stoves
    - ❖ Electric motors and pump sets
    - ❖ Electric ceiling and pedestal fans
    - ❖ Computer and television displays
    - ❖ Office copiers and printers.
- Institute comprehensive industrial and commercial sector EE&EC improvement programmes including plant audits, technical, operator and management training, product supply and servicing, testing, standards and certification and financing for:
    - ❖ Boiler/furnace tune-up replacement and water treatment
    - ❖ Gas combustion controls
    - ❖ Steam/cogeneration/waste heat recovery systems
    - ❖ Electrical systems, motors, pumps and variable speed drive
    - ❖ Central HVAC systems
    - ❖ Building design, materials, lighting and controls
    - ❖ Street and public lighting
- Devise national passenger/freight vehicle and tractor fuel efficiency standards vehicle testing and certification programme and expand modern tune-up and diagnostic facilities nationwide.
- Design and implement a nationwide CFL for incandescent replacement programme through effective distribution/sales, exchange, recycling and quality assurance programmes with manufacturer/vendor, utility and government involvement.
- Design and implement utility-led DSM programmes in electricity and gas markets through EE&EC product and information dissemination, innovative metering, billing and crediting

systems and other consumer reward/penalty schemes for inducing base load reduction and peak shifting.

- Improve efficiency and reduce losses in energy supply infrastructure, particularly in power and gas generation T&D transformation, compression, pumping and storage systems and replacement of inefficient fuel transportation (e.g road) with more economical alternatives (e.g pipelines and rail) where feasible.
- Develop cross-sectoral EE&EC financing solutions and facilities (e.g concessional and guaranteed loans and grants, multi-year revolving funds on bill and voucher schemes, subsidized equipment supply/replacement, etc) involving public, donor, commercial, micro, utility ESCO and vendor institutions.
- Enhance relevant EE&EC awareness technical management, manufacturing and service levels amongst targeted stakeholder groups (industry, vehicle operators, households, architects and builders, academia etc) including international collaboration with local manufacturers and seller's technology licensing/transfer and relevant quality assurance, testing and certification facilities.
- Facilitate development of DSM programmes and ESCO operations in selected markets through appropriate technical marketing and financial assistance to utilities, private sector actors and consumer groups.
- Develop EE&EC information collection analysis and dissemination centers at the national and regional levels for EE&EC potential upgrade, retrofit and technology assessments, audits, simulations and evaluations project and investment identification and design business cases and best practices service and product sourcing, financial and technical feasibility assessment, financing and implementation advisory services etc.

**Capacity Development and Mainstreaming**

- Mainstream EE&EC into national energy infrastructure, economic and development planning and project approval processes including EE option assessments as part of national integrated energy modeling activities.
- Develop plans and institutional capacities for achieving long-term modal shifts in transportation (e.g to non-motorized transport, mass transit, railways etc) and large-scale fuel shifts (e.g to CNG in public transportation, biofuels, hybrid vehicles, renewable energy, etc) that help lower energy use intensity.
- Expand and strengthen binding public and private sector EE&EC provisions to include large building energy simulations, minimum appliance and lighting efficiency standards, institutionalized energy management and rewards programmes power factor correction and other measures designed to improve efficiency of overall existing and new government and privately owned energy consuming stock and operations in the country.
- Initiate assistance to city and town administrations and urban development agencies in integrating EE&EC into planning and zoning, road and transportation system design,

building EE regulation and municipal services and infrastructure (street lighting, mass transit, water and sewage treatment etc).

- Institute federal, provincial and local level EE&EC planning and implementation capacity amongst relevant government administrative bodies major industrial and consumer groups and product and service suppliers.
- Review and augment on self educational material viz EE related content at primary and secondary school levels adjust to Pakistan context and disseminate.
- Enhance technical education in specialized schools and universities and introduce in their teaching curricula EE&EC specific tools and methods (e.g technical and economic evaluation, life-cycle cost of equipment, energy auditing and accounting etc) and related information (e.g on building design, construction practices and material properties power factor and harmonic distortion, HVAC systems, efficient devices etc) in order to provide necessary technical expertise to serve an expanding national EE&EC market. Recently, ENERCON has developed new Building Energy Code, which has been approved by Pakistan Engineering Council. The codes will be tabled for legislative approval before implementation.

## 4.4 Long Term Strategy

### 4.4.1 Period

- Years 6 and beyond

### 4.4.2 Objectives

- Gradual achievement of targeted energy intensity levels in main economic sectors as set out in Action Plan.
- A mature self-sustaining and growing indigenous Pakistani EE&EC market in the supply manufacture R&D maintenance, financing and use of relevant products and services by major energy supplier and consumer groups.
- Established base of relevant policies, regulations and legislature for promoting and protecting EE&EC activities and investments by all stakeholders.
- Most barriers to public and private sector EE&EC actions removed with broad awareness of efficient energy use benefits, options and methods amongst all end-user categories.
- Comprehensive mandatory provisions and voluntary guidelines in place for effectively restricting accumulation of inefficient energy consuming stock and ensuring minimum EE standards in all major new equipment and asset acquisition, manufacture and construction in the country with significant upgrade tune-up, retrofitting and replacement of existing stock underway (especially in industry, vehicles, buildings, appliances and tubewells).
- Complete phasing out of inefficient and polluting technologies from the national economy (e.g incandescent and mercury vapor lamps, two-stroke internal combustion engines etc) and replacement with efficient, clean alternatives (e.g CFLs, hybrid engines, renewable energy etc).

- Provision of efficient mass transit and improved public and non-motorized transportation facilities in all major urban centers.
- Optimal use of rail transportation for inter-city passenger and freight movement.
- Widespread use of dispersed renewable and alternative energy systems (especially rooftop PV panels, solar thermal water heaters, micro wind, Hydro generators and biogas plants) in urban and rural households and communities to supplement networked supplies.
- Elimination of traditional biomass combustion for household cooking and heating needs displaced by modern conventional and renewable energy supplies, use of biomass waste primarily for soil conditioning, biogas production, biofuels and power generation.
- Institution of safe municipal solid waste disposal systems in all major urban areas and methane recovery from properly managed landfill sites.
- Strong planning and institutional support capacity within the Government business, donor and civil society for EE&EC implementation within all end-user categories, ranging from large consumers to low income groups.
- Continuation of long-term national EE&EC planning based on monitoring and review of medium term actions and in line with increasing implementation capability and market sophistication.

### 4.4.3 Action Areas

- Specific actions for the long-term would continue build upon and expand activities undertaken during the short and medium terms with an enhanced scope based on strengthened national EE&EC capacity, growing economic and market sophistication and prevailing energy situation.
- Details of such activities and focal areas would be determined and designed during the medium term planning process.

## 4.5 Next Steps

The report proposes several immediate steps that should be taken by the Government to initiate the national EE&EC programme outlined above these consist of:

- Preparatory activities for developing and launching the strategy and detailed work plan indicated above
- Feasible no or low cost Government actions such as specific policy measures and regulatory directives that can affect obvious EE&EC benefits or remove existing contradictions and anomalies in this respect
- Investment opportunities with immediate payback that do not involve extensive precursor activities (such as comprehensive policy or legal reforms institutional strengthening, market development, requiring a long lead time).

These immediate steps are enumerated upon in the following sections and should serve as an illustration of other such actions that can be added to each category as considered appropriate during the course of programme initiation and development. It is expected that these initial steps

would be undertaken and completed within twelve calendar months of the approval and initiation of Pakistan's EE&EC programme both to provide the necessary base for launching more detailed and comprehensive programme activities as well as committing and imparting significant visible momentum and urgency to the initiative, while realizing instant energy savings by capturing available “low hanging fruit”. International assistance can be channeled appropriately into each of these categories. For instance, ADB could provide technical assistance to the Government both for undertaking some preparatory activities identifying and enacting immediate policy and regulatory reforms and providing financing for some of the EE&EC investment opportunities and market interventions identified.

### 4.5.1 Preparatory Activities

The main propose of the preparatory activities for launching the national EE&EC strategy and programme development effort would be to provide an interim base to coordinate and oversee initial actions until such time that more permanent institutional arrangements and programme ownership can be established. Towards this end a sufficiently representative technically competent and administratively empowered EE&EC Working Group should be established and hosted at the Planning Commission, Government of Pakistan to identify and elaborate upon initial Government actions required ensure preliminary stakeholder and donor consultation allocate task and subgroup responsibilities and ensure proper sequencing and implementation of all preparatory activities. The actions to be taken in this respect include

- Definition of the composition and terms of reference for the EE&EC WG and approval by the Government's Task Force on Energy.
- Establishment of the EE&EC Working Group (WG) with appropriate secretariat support.
- Thereafter, all existing and new Government policies, regulations, programmes and funding directly relevant to EE&EC in Pakistan should require an overview and consent by the EE&EC WG to ensure proper coordination and prevent further conflicts or anomalies until a more permanent policy review mechanism is established under the EE&EC work plan.

### 4.5.2 Immediate Actions and Reforms

Recommendations for immediate policy and regulatory reforms would be one of the main tasks of the EE&EC WG. However, several preemptive initiatives in this respect can be undertaken under EE&EC WG coordination, where obvious benefits or anomalies can be readily identified. These could include:

- Abolishing the existing customs duty on compact fluorescent lamps (CFLs), high pressure sodium (HPS) lamps and light emitting diodes (LEDs) and arrays of all energy ratings and imposition of additional surcharge on sale of ordinary tungsten incandescent lamps (i.e excluding special purpose sizes and halogen incandescent lamps).
- Mandating use of efficient quality-certified CFLs, high-pressure sodium, T5 or T8 fluorescent or metal halide lamps in place of mercury vapor and T12 fluorescent lamps

in all public lighting applications including municipal street lamps, highway lighting, airports, stadium and other such large public facilities.

- Reviewing customs and sales tax regime for EE&EC equipment to allow for exemptions for efficient alternatives (variable speed drive controls, cogeneration systems, power factor correction capacitors, CNG conversion kits, computerized engine diagnostic and tune-up equipment, energy control and management devices, thermal insulation materials, RE equipment etc) and surcharges for inefficient alternatives (mercury vapor lamps, used and low-efficiency machinery etc) including preparing detailed lists of such items and devices for proper notification.
- Finalizing, on a priority basis plans and schemes for implementing rapid mass transit systems in major cities (Karachi, Lahore and Islamabad/Rawalpindi) with targeted financing sources and completion schedules for all three metropolises.
- Specifying and mandating use of certified thermal roof insulation materials, CFLs and T8/T5 fluorescent lamps in all new public-sector buildings at the federal and provincial levels and as applicable in military construction.
- Mandating minimum compliance requirements with the Pakistan Building Energy Code for all large (based on covered area or projected energy use requirements) public-sector buildings and recommend municipal authorities to encourage private construction to follow similar guidelines.
- Requiring all large commercial and multipurpose building and urban development projects to explicitly indicate EE, conservation and waste water and heat recycling measures incorporated into project design as a mandatory component of the environmental impact assessment (EIA) approval process.
- Providing phased budgetary allocations for mandatory annual vehicle tune-up of all government owned road transport fleets to improve fuel performance as well as create a commercial market for computerized diagnostic and tune-up facilities in the private sector.
- Allowing OMC's to expand number of dispensing stations and sales volumes for ethanol-blended gasoline (E10) across the country as per availability of supplies.
- Initiating planning of efficiency enhancement of utility T&D systems specifically electricity distribution grids and natural gas pipeline compression facilities.

### 4.5.3 Investment and TA Opportunities

Given the estimated large potential for EE improvements in Pakistan, several opportunities exist that can be readily tapped into without the need for extensive precursor preparations detailed policy design or framework development for achieving immediate payback in terms of energy savings and deferred additional supply requirements. While an exhaustive survey of such options is beyond the scope of this study a few are listed here for illustrative purposes to highlight their implicit economic feasibility based on a preliminary analysis of available country data. Further refinement and expansion of such options could

result in a portfolio of immediate bankable EE&EC investment and technical assistance options available in Pakistan that may be considered by the Government, ADB and other financing agencies. Some of these options have been investigated here in more detail than others as allowed by availability of relevant information. The choice of which programmes are selected for actual implementation from amongst the portfolio (or as may be identified otherwise) would be limited by both the available financing and necessary technical assistance as well as appropriate institutional platform required for executing them within the first year given the shortcomings of the existing EE&EC implementation capacity in the country.

## 4.6 Residential Sector

### 4.6.1 Domestic CFL Disbursement Programme

Given the large and growing segment of domestic consumers in Pakistan's power demand (currently consuming 44.3% of total supply) residential sector DSM programmes deserve high and immediate attention. Since lighting is an essential and primary domestic use of electricity, replacement of inefficient incandescent lamps with more efficient household lighting fixtures (such as CFLs and LEDs) can significantly impact total household electricity consumption, especially amongst the bulk of the power utilities customers that consume less than 100 units (kWh) per month where lighting loads represent a high proportion of overall power consumption. A simple mechanism to expedite the penetration of efficient CFLs into the domestic consumer market is to inject a large volume of such devices at highly subsidized rates or on free of cost basis. The rational of this approach, which has been used successfully in several countries, is several folds:

- The comparative higher cost of CFLs compared to incandescent lamps is an important barrier to their widespread use. Supplying them at artificially low or no cost allows access to households that may otherwise not use them and once the greater lifetime benefits of such devices are understood through first-hand experience can help create a much larger future consumer demand for CFLs in the local market.
- Instant energy savings for both the consumer and the utility can be realized through such action rather than waiting over a much longer period for market driven CFL replacement to take place. Importantly, these savings would greatly influence peak demand reduction on the utilities load curves as lighting is a major contributor to evening load peaks. The economic value of the resulting energy savings is thus higher in terms of generation capacity released for other uses as well as in terms of the avoided cost of additional peaking units.
- Since a large majority of domestic energy customers represent lifeline or low consumption categories, a reduction in their electricity demand would result in immediate savings in subsidies that are implicit in the lower tiers of the Government's retail tariff structure.
- The reduction in monthly electricity consumption bills for the consumers provides a strong motivation for high utilization of the disbursed CFLs especially amongst the low-

income categories. This would result in additional social benefits such as increased disposable incomes and improved home lighting, which can positively impact poverty alleviation, gender inequities and educational attainment levels while at the same time avoiding the pitfalls of consumer rejection or indifference that often plague subsidized or free of cost product distribution programmes.

The programme would consist of distributing free of charge, one CFL to each domestic customer in the country with an average monthly electricity consumption of 100 kWh or less. This category of customer represents roughly 80% of the 14,837,490 WAPDA and KESC domestic connections i.e 11,869,992 customers. The Government notified electricity tariff applicable to this consumer category is Rs 2.65/kWh. The calculated average subsidy per unit paid by Government to the DISCOs is Rs 1.02/kWh. Two scenarios have been considered:

- Replace 100 W incandescent bulbs with 26 W CFLs (with lumens produced rated equivalent to those from 100 W incandescent lamps)
- Replace 60 W incandescent bulbs with equivalent-lumen 14 W CFLs

Several simplifying assumptions have been made in this analysis. The programme is not deemed affected by the present level of CFL penetration in the domestic consumer market as it is assumed that virtually all CFLs distributed will in any case either be immediately utilized to replace existing fixtures or used to avoid additional incandescent purchases or stored for future use or traded with others who will also follow the same usage pattern. Thus, it does not matter who ultimately uses these devices or when they are eventually used as long as they are used & will displace other available alternatives, primarily incandescent and result in either immediate or deferred benefits. The prices used for CFLs have been drawn from existing international experience in similar programmes, although it can be assumed that lower costs could be negotiated for bulk purchases. Programme management is considered to be the DISCOs responsibility and related programme management costs as well as marketing benefits to the DISCOs are not included in these estimates. The results of even a onetime single CFL disbursement programme would be impressive as summarized below for each of the two scenarios:

### 4.6.2 Disbursement of Single 26 W CFL Per Consumer

Total up-front programme investment of Rs 1.78 billion (US$ 29.7 million) for the procurement of CFLs (based on a market price of Rs 150 per lamp) resulting in system wide energy savings of 1,757 GWh over the lifetime of the lamps. Total on bill savings for domestic consumers of almost Rs 4.7 billion (USS 77.6 million) over the 2,000 hour operational lifetime of the CFLs or an annual savings of over Rs 2.54 billion. This represents a significant amount of money that would be re-injected into the economy rather than being wasted in operating inefficient incandescent bulbs. The actual monetary savings for the consumer would be even higher if the replacement cost of short-lived incandescent lamps is also factored in. Savings for the Government in terms of avoided consumer tariff subsidies to the tune of Rs 11.4 million (USS 0.19 million) over the lamps lifetime resulting in a net cost of programme per kWh saved of USc 1.7 or only 21%

of the current average system wide delivered cost of electricity of USc 8.0/kWh.

A maximum avoided power demand amounting to 878 MW. The cost of such additional new generation capacity would be USS 1.14 billion (assuming US$ 1.3 million/MW as the marginal cost of new generation capacity). It is noteworthy that these savings in demand represent about 44% of the peak capacity shortfall of approximately 2,000 MW experienced by the country during last summer.

A minimum total budgetary savings to the Government in terms of avoided generation costs and tariff subsidies minus programme cost of Rs 66.74 billion (USS 1.12 billion) as a result of the programme. This does not include the additional T&D infrastructure costs and losses avoided due to the resultant load demand reduction. The total economic benefit of the program to the country would of course be much greater in terms of better generation capacity utilization reduced fuel consumption social and poverty reduction benefits, lower environmental costs etc.

### 4.6.3 Disbursement of Single 14 W CFL Per Consumer

Total up front programme investment of Rs 1.07 billion (USS 17.8 million) for the procurement of the CFLs (based on a price of Rs 90 per lamp) resulting in system wide energy savings of 1,092 GWh over the lifetime of the lamps. Total on bill savings for domestic consumers of almost Rs 2.9 billion (USS 48.2 million) over the approximately 22 month lifetime of the lamps (assuming a 2,000 hour operational lifetime and three hours per day of use) or an annual savings of over Rs 1.58 billion. Savings for the Government in terms of avoided consumer tariff subsidies of Rs 45.6 million (USS 0.76 million) over the lamps lifetime resulting in a net cost of programme per kWh saved of USc 1.6.

A maximum avoided power demand amounting to 546 MW or approximately 21% of current peak system wide capacity shortfalls. The cost of such additional new generation capacity would be about US$ 0.71 billion.

A minimum total budgetary savings to the Government in terms of avoided generation costs and tariff subsidies minus programme cost of Rs 42.54 billion (US$ 709 million) as a result of the programme. Again, the associated financial savings and economic benefits would make the overall attractiveness of the programme much greater.

The programme outlined above could easily be modified by combining both 26W and 14 W CFLs, increasing the number of lamps per consumer using better quality lamps (i.e 3,000 hr lifetime) expanding the target population to higher consumption brackets or adding a CFL replacement / recycling component. The cost and benefit of such what if scenarios can be readily computed using the computer spreadsheet. For instance, the net programme cost turns negative (tariff subsidies saved exceed cost of CFLs purchased) if two instead of one 26 W CFL is disbursed per customer, doubling the peak avoided power demand to 1,757 MW and resulting in total Government financial savings of Rs 137 billion (US$ 2.28 billion).

**Domestic Water Heater Timer Control Retrofit Programme**

Another immediate term investment opportunity in the domestic sector relates to improving the efficiency of natural gas based storage water heaters, which are widely used in the

urban residential sector especially in central and northern Pakistan where winters are relatively more severe. The measure involves provision of automatic thermostat timer devices that can switch water temperature settings according to a consumer defined schedule based on actual water usage rather than remaining at a fixed setting subject to manual alteration. Such a measure could result in significant winter time gas consumption reduction which is the peak demand season for gas utilities that are constrained to curtail industrial supplies in order to service domestic loads. Thus, the economic benefits of such a measure would again be multiple better peak load management use of gas for productive industrial purposes, high cost of avoided LNG fuel imports, reduced expansion of gas production and transmission facilities, etc.

The financial and energy savings for this measure require further data based on availability and suitability of such devices and cost of installation, which can be quickly undertaken. The final programme cost could be shared with the respective gas utility as it would represent significant avoided costs for the supplier in addition to reducing the consumer's gas bill as well as the need for non-productive but politically sensitive cross-subsidies.

## 4.7 Municipal and Urban Sector

### 4.7.1 HPS Streetlamp Replacement Programme

Today, street lighting in developed countries commonly uses high-intensity discharge (HID) lamps often high pressure sodium (HPS) lamps. Such lamps provide the greatest amount of photo picture illumination for the least consumption of electricity. For example, 400W HPS lamp produces 125 lumens per watt (LPW) compared to only 68 LPW for mercury vapor or a 46% higher EE and has a similar operating lifetime. On average North American and European cities utilize 180,000 street lamps per million population which operate for 11 hours a day. Thus, if a city such as Islamabad with a population of roughly 1 million were to meet developed country street lighting standards it would require 17 MW of power generation for this purpose and consume 69.4 GWh of electricity a year, based on a typical HPS lamp consumption of 96 W compared to about 27 MW of power and over 108.4 GWh of consumption for equivalent mercury vapor lamps of 150W rating.

Islamabad and most large urban centers of Pakistan have already shifted to HPS street lamps for new streetlight installations and partial replacement of existing mercury vapor lamps. However, large numbers of mercury vapor street lamps remain in operation in the country, especially in smaller towns and cities. Given that Pakistan's total urban population is presently in excess of 54 million requiring almost 10 million street lamps if European standards are applied the potentially huge energy savings in terms of efficient street lamps (as well as other public lighting) can be appreciated.

In 2008-09, the total annual combined WAPDA and KESC system consumption for public lighting (including street lighting) stood at 6,688 GWh. Based on this, a sample calculation is shown below for the potential energy savings possible. This example assumes that 60% of current public lighting electricity consumption in the country is used for street lighting and that roughly half of the street lights still use MV lamps. If these remaining approximately

3.3 million fixtures are replaced with higher efficiency HPS lamps and a replacement/installation cost of Rs 900 (US$ 15) per pole is used, assuming the existing lamp housing is retained and ignoring incremental programme management overheads, the total cost of a countrywide street light upgrade programme for Pakistan would be Rs 3 billion (US$ 50 million). However, the replacement would result in about 180 MW of power generation being avoided costing Rs 14 billion (US$ 234 million) and result in annual electricity savings to the municipalities of Rs 5.5 million (US$ 0.09 million), which would add up to over Rs 34 million (US$ 0.57 million) over the 25,000 hours lifetime of the HPS lamps. Thus, the total lifetime financial benefit to the Government would be over Rs 11 billion (USS 184.5 million) in terms of one-time.

**Table: 15 Municipal HPS Street lamp Replacement Programme**

| | | | |
|---|---|---|---|
| **Assumptions** | | | |
| | Annual total public lighting electricity consumption, 2007-08 (GWh) | 6,688 | |
| | Fraction of public lighting electricity consumption used for street lighting | 60% | |
| | Average daily street lighting use (hr) | 11 | |
| | Fraction of MV lamps in existing street lights | 50% | |
| | Fraction of HPS lamps in existing street lights | 50% | |
| | Fraction of MV lamps and ballasts to be replaced by HPS [amps and ballasts | 100% | |
| | Average MV lamp rating (W) | 125 | |
| | Average MV ballast rating (W) | 25 | |
| | Average HPS lamp rating (W) | 70 | |
| | Average HPS ballast rating (W) | 26 | |
| | VSD upgrade lifetime (yr) | 10 | |
| | Average operational life for MV and HPS lamps (hr) | 25,000 | |
| | | Rs | US$ |
| | Cost of HPS lamp, ballast, igniter, capacitor, etc., Installation/lightpole | 900 | 15 |
| | Cost of avoided generation capacity (/kW) | 78,000 | 1,300 |
| | Applicable electricity tariff, IESCO (/kW) | 7.59 | 0.13 |
| **HPS Replacements** | | | |
| | Electricity Consumed by street lights (GWh/yr) | 4,013 | |
| | Power required for street lights (MW) | 999 | |
| | Power required for existing MV lamps (MW) | 500 | |
| | Power required for existing HPS lamps (MW) | 500 | |
| | Number of MV lamps to be upgraded with HPS lamps | 3,331,507 | |
| Programme | | | |
| | | Rs | us$ |
| | Total replacement cost | 2,998,356,164 | 49,972,603 |
| Programme Impact | | | |
| | Power savings per light pole (W) | 54 | |
| | Total power savings due to HPS replacement (MW) | 180 | |
| | Total annual energy savings (GWh/yr) | 0.72 | |
| | | Rs | US$ |
| | Total annual savings in electricity costs for street lighting | 5,482,287 | 91,371 |
| | One-time savings, on avoided generation costs | 14,032,306,849 | 233,871,781 |
| | Annual Government savings on tariff subsidy | - | - |
| | HPS lifetime savings in electricity costs | 34,136,285 | 568,938 |
| | Total programme financial benefit (avoided costs + energy savings - programme cost) | 11,068,086,970 | 184,468,116 |

Metal halide lamps provide similar efficiency gains over mercury vapor lamps where white light is required such as in commercial, industrial and sports lighting applications and may also be targeted for improvement in the case of selected large loads (e.g airports, stadiums etc). Financial assistance in expediting HPS installation and replacement along with better streetlamp

regulator and timing devices can be taken up immediately to improve both energy savings as well as providing the many other economic and social benefits that improved street and other public lighting can bring.

### 4.7.2 LED Traffic Signal Replacement Programme

Traffic signals by necessity usually operate 24 hours a day 365 days a year. Solid-state light emitting diodes (LED) can now produce white and colored light at much higher efficiency than equivalent incandescent illumination and are becoming widely accepted as a replacement for the latter in traffic signal lights and other illuminated roadway hazard warning and signage devices. Because of their small size they are used by the hundreds in arrays to fill the entire lamp area and therefore, provide better and more uniform visibility while still consuming only 15-20 W instead of 100-150 W for equivalent halogen incandescent lamps. In addition, LED's last for years compared to months for incandescent lamps further reducing lifetime replacement and maintenance costs.

Major urban cities in Pakistan have already begun using LED lamps in traffic signals but many older signals continue to use incandescent lamps. A mandatory conversion of all traffic lights to LED use as well as in the case for all new installations would dramatically reduced the amount of electricity required now and in the future for this purpose as Pakistan's cities and road networks experience rapid expansion.

A financing programme to help municipalities implement an LED traffic signal replacement and implementation plan across the country could be readily devised to help reduce electricity consumption for this purpose on an immediate basis with very attractive life cycle O&M savings and payback. For example, the annual energy savings per pole for 12W LED lamps replacing 135W incandescent lamps for standard 12" signal housing would be approximately 1,023 kWh. In the IESCO region, the tariff for public lighting is currently Rs 7.59/kWh translating into an annual possible savings per pole of Rs 7,765 (US$ 130), while the replacement cost for the LED lamps would be only US$ 20 per pole.

## 4.8 Transportation Sector

### 4.8.1 Vehicle Engine Diagnostics and Tune-up Programme

The ENERCON, FERTS project was an important attempt at improving vehicle engine maintenance practices in the country that could result in significant savings of imported oil. However, since the culmination of GEF assistance to the project in 2005, the momentum achieved in setting up auto tune-up facilities across the country and training technicians in proper engine diagnostics and servicing has been lost. Given the importance of such a programme for the country's road transport sector, especially in view of the staggering growth of the automobile sector in recent years and before relevant institutional memory and project assets are completely dissipated, it would be advisable to revive this initiative through additional external funding and continued technical support. During this phase of project implementation significant scaling up of targeted tune-up facility installations should be considered with appropriate resource allocation and implementation planning. In the interim that ENERCON's role in a revised

national EE&EC institutional setup can be better defined such a programme can continued to be housed at ENERCON which could be suitably strengthened through appropriate short-term capacity augmentation specifically for this purpose in order to utilize existing Government resources optimally in the immediate term.

### 4.8.2 Speed Regulators on Public Transport Bus Programme

Most urban centers in Pakistan rely on private operators to provide public road transportation using buses, vans, taxis and auto-rickshaws. Private bus and van fleets also comprise the bulk of intra-city public road transportation capacity. Due to competition between different operators on the same route, these buses and vans often exceed applicable speed limits in an effort to pick up more passengers or increase trip numbers, which not only represents a serious road safety hazard (bus and van accidents on highways and pedestrian collisions in cities are common place) but also results in excessive diesel consumption. One way to help address both issues would be to institute mandatory speed governors on all such registered vehicles, which would prevent them from exceeding a preset speed limit. Such a programme would involve financing of the speed regulators and their installation, cooperation from several agencies and an annual certification system to ensure that the devices are not tampered with. To test such arrangements and evaluate results it is suggested that the programme be initiated at a pilot level during the first year.

## 4.9 Industrial Sector

### 4.9.1 Industrial VSD Installation Programme

The bulk of industrial electricity consumption is used to power electric motors often representing up to 75% of total plant load. Apart from the use of modern energy efficient motors, the installation of adjustable or variable speed drive (VSD) controllers on AC motors can save significant amounts of electricity consumed by reducing rotational speed when the process requirement is being driven by the motor falls, such as air flow through a fan or liquid flow through a pump. This is more efficient than running the motor at a constant speed and regulating the process downstream of the motor (such as through air dampers or control valves).

VSD controllers can be retrofitted onto existing AC motors in use and can cut down average motor energy consumption by a half. Although detailed data on electric motor use in Pakistani industry is not readily available a rough calculation can be done to estimate the impact of implementing a VSD installation programme in the sector, which is shown below. The assumptions used in this analysis are highly conservative and broad they can easily be refined however, if more detailed industrial motor data are made available. As such, the evaluation provides an indicative estimate of the energy savings possible through an industry wide VSD programme and may underestimate the actual total potential savings possible. As the table shows, the programme would target some 35,000 AC motors of 25 horsepower (hp) average rating. The total programme cost for procurement and installation of VSD retrofits on these motors would be Rs 3.5 billion (US$ 58.2 million). The resulting reduction in power requirement would be of the order of 280 MW, which would represent an avoided additional generation capacity cost of Rs 21.8 billion (USS> 364 million). It would also result in savings to the Government in the applicable electricity tariff

(Industrial B-2) of Rs 9.3 billion (US$ 154.9 million) over the assumed 10-year lifetime of the VSD controllers, while saving industry Rs 160,956 (US$ 2,683) per motor annually in terms of reduced power and energy charges on their electricity bills totaling Rs 56.2 billion (US$ 937 million) across industry over the programme's lifetime. The total lifetime budgetary savings for the Government resulting from the programme consisting of the one-time cost of additional power generation capacity avoided and lifetime tariff subsidy savings minus programme cost would also be a substantial Rs 27.6 billion (US$ 460.6 million). This estimate does not include programme management costs, nor does it estimate additional economic benefits resulting from better utilization of saved energy avoided T&D losses, or the impact of re-injecting almost a billion and a half dollars back into the economy. Since the financial benefit to both industry and Government of such a programme would be significant programme cost-sharing arrangements between the two would be a practical implementation method in this case.

**Table: 16 Industrial Sector VSD Installation Programme**

| Industrial Sector VSD Installation Programme | | | |
|---|---|---|---|
| **Assumptions** | | | |
| | Annual total industrial electricity consumption, 2007-08 (GWh) | 11,070 | |
| | Fraction of industrial electricity consumption used in electric motors | 50% | |
| | Fraction of industrial motors to be upgraded with VSDs | 50% | |
| | Average annual operational time for industrial motors (hr/yr) | 4,000 | |
| | Reduction in motor electricity consumption after VSD upgrade | 50% | |
| | Average nominal power rating of 25 hp industrial motors (kW) | 19.80 | |
| | Average actual motor power consumption without VSD (kW) | 16.02 | |
| | Average actual motor power consumption with VSD (kW) | 8.01 | |
| | VSD upgrade lifetime (yr) | 10 | |
| | | Rs | US$ |
| | Cost of VSD installation/motor | 100,000 | 1,667 |
| | Cost of avoided generation capacity (/kW) | 78,000 | [1] 1.300 |
| | Applicable industrial electricity tariff B-2, 21-500 kW | | |
| | Power (/kW) | 364.32 | 6.07 |
| | Energy (/kWh) | 3.93 | 0.07 |
| | Subsidy (/kWh) | O.B3 | 0.01 |
| **Motor Upgrades** | | | |
| | Electricity consumed by industrial motors (GWh/yr) | 5,635 | |
| | Power required for industrial motors (MW) | 1,384 | |
| | Power savings with VSDs (MW) | 692 | |
| | Number of 25 hp industrial motors in use | 69,888 | |
| | Number of 25 hp industrial motors to be upgraded with VSDs | 34,943 | |
| Programme Cost | | | |
| | | Rs | US$ |
| | Total upgrade cost | 3,494,318,182 | $8,238,636 |
| Programme Impact | | | |
| | Total power savings due to VSDs (MW) | 280 | |
| | Total annual energy savings (GWh/yr) | 1,120 | |
| | | Rs | US$ |
| | Total annual savings on power charge per upgrade | 35,023 | 584 |
| | Total annual savings on electricity bill per upgrade | 125,933 | 2,099 |
| | Total annual savings per upgrade | 160,956 | 2,683 |
| | One-time savings on avoided generation costs | | 363,908,778 |
| | | 21,834,526,705 | |
| | Annual Government savings on tariff subsidy | 929,367,034 | 15,489,451 |
| | VSD lifetime Government savings on tariff subsidy | 9,293,670,341 | 154,894,506 |
| | Total programme financial benefit (avoided costs •*• tariff savings - programme cost) | 27,633,878,864 | 460,564,648 |

### 4.9.2 Industrial EE Financing Programme

Since the termination of the USAID funded ENERCON technical assistance programme in 1990, there has been no meaningful institutional support to public and private industry for

undertaking energy audits, retrofits, replacements, technology upgrades and associated transfer of knowledge. As a short-term precursor to a more comprehensive and sustained industrial EE&EC programme to revive the Energy Conservation Fund (ECF) previously established at ENERCON for financing private EE&EC initiatives by industrialists themselves, including, but not limited to:

- Energy audits and surveys
- Boiler and furnace tune-up and replacement
- Thermal systems upgrades, including combustion controls and steam systems
- Power factor optimization and reduction of harmonic distortions
- Electric system, lighting, and motor improvement and replacement
- Cogeneration, waste heat recovery, and process optimization

ECF seed funding to the amount of US$ 3 million provided by GEF has been available with ENERCON for the past several years, but the agency has been unable to institute a working loan disbursement arrangement so far. It is recommended that the fund be transferred to a more effective host institution and a financial intermediary with a track record of industrial financing and nationwide presence be appointed immediately. A competent fund manager can be tasked to devise practical fund disbursement and repayment criteria which should be approved by the Government before implementation begins.

The programme may be re-titled more accurately as the Energy Efficiency Fund (EEF) and would need to be accompanied by an effective promotional campaign to alert industry to the facility, eligibility criteria and application procedures. Fund amounts can be gradually increased through further contributions from donors, accompanied by matching injections by the Government. A timeline for the effective utilization of the revolving fund should aim to achieve full disbursement of the initial ECF financing capacity within the first calendar year of its implementation.

### 4.9.3 Standards, Testing, and Certification

In the interim that Pakistan can develop a comprehensive EE&EC standards testing and certification regime for different categories of energy consuming equipment and stock existing international standards can easily be leveraged where possible to affect a positive change in the accumulation of new stock. Such measures would rely on international standards testing, certification and labeling that is already universally adopted particularly with respect to imported products as well as some standards that can be implemented easily for certain domestically manufactured goods. Examples of such categories and schemes include, but are not limited to the following:

### 4.9.4 International Energy Certification for Office Equipment Programme

Computers, monitors and displays printers and photocopiers represent a significant and increasing load component for most modern offices regardless of their size and contribute to the power utilities daytime peaks. International EE rating programmes such as the US Energy Star and the European TCO certification series are currently applied to most such products

manufactured overseas.

The Government can mandate that only such EE compliance certified office equipment may be imported into the country and impose penalties on the import of non-conforming products through the existing Customs inspection regime.

### 4.10 Pakistan Building Energy Code Programme

The Pakistan Building Energy Code and compliance handbook was produced under the USAID-ENERCON programme in 1990, but not a single large building constructed in Pakistan since then can be certified as conforming to code requirements. This has been due to a lack of code dissemination and training effort on the part of the government with the result that most builders, developers, architects, HVAC designers and building material and equipment manufacturers remain unaware of the guidelines.

It is recommended that the implementation of the Pakistan Building Energy Code developed by ENERCON to implement in the country and be revived through appropriate awareness raising, training and technical support. The aim should be to make the code and its potential benefits highly visible within Pakistan's burgeoning construction industry within the first year and to realize actual compliance by large public and commercial buildings, initially voluntarily through appropriate incentives but ultimately through mandatory regulations. In the first year for instance, compliance with the code could be included in the requirements for the approval of the environmental impact assessments (EIAs) of large commercial and multipurpose public buildings and facilities.

### 4.11 Testing, Certification, and Labeling of Thermal Insulation Materials Programme

As mentioned earlier, building roof insulation is one of the few EE&EC measures that have been widely adopted by the Pakistani construction industry, building owners and occupants. A range of thermal insulation materials of varying specification quality and properties is readily available in the local market comprising of both locally manufactured and imported products. Several companies specialize in roof insulation installation and retrofits sometimes involving multiple layer / product treatments. However, none of the commercially available materials is properly labeled or certified in terms of its thermal insulation properties (e.g R-values) making verification of competing vendor claims and comparison by customers both difficult and often misleading. Testing of such materials or multilayer assemblies for at least their basic thermal properties (i.e heat conductivity and capacity) not withstanding other important but secondary attributes (weather and UV resistance, water seepage, load bearing capacity, etc) can be easily carried out by the PSQCA. Such basic information, if appropriate advertised and accessible on the web, would not only educate consumer choices better but also help root out sub-standard and ineffective products from the market that degrade achievable energy and monetary savings. The required test results can easily be obtained and disseminated publicly within one calendar year with appropriate supportive Government regulation requiring that all manufacturers carry the subsequent PSQCA rating on their products and promotional materials as well as minimum specifications for government procurement of such certified materials for all public-sector building projects.

## 4.12 Vehicle Fuel Efficiency and Emissions Standards Programme

Motor vehicle fuel performance and exhaust emission standards exist in most developed countries and several developing nations. Since automobile manufacture and imports are highly centralized operations, such regulations can be easily promulgated and enforcement monitored provided the government takes the lead in instituting them. The standard practice is to define fuel efficiency and emissions standards for different categories (e.g engine sizes) of vehicles, institute a testing and certification programme and impose a punitive tax on those vehicles that fail to meet the applicable standards.

Pakistan is experiencing a dramatic increase in road transportation use road traffic has been increasing at an average annual rate of 14.1% in the 20 years since 1989, while more recently the local automobile and motorcycle manufacturing capacity has grown spectacularly. While instituting a comprehensive vehicle fuel and emissions standards testing and certification regime will require significant time and effort, a start towards this goal can be initiated immediately. For instance, if certain international standards can be adopted locally, multinational automobile companies can be forced to implement them in their local manufacturing facilities rather than implementing lower quality engine technology in the country, as is often the case at present. Similarly, imported vehicles can be required to conform to such standards or face addition custom and excise duties.

A brief study can be conducted to review current international vehicle standards and regulations, and appropriate elements adopted for Pakistan as many other regional countries have done. For instance, India started adopting Euro 1 to 4 emission standards in 2000 for automobiles, light diesel vehicles and interstate buses and Euro 2 and 3 standards for two-wheelers in 2005 and 2008 respectively. These standards are also gradually being extended to all diesel trucks and buses. Similarly, China applied Euro 1 standards in 2000 upgrading to Euro 2 in 2005 and Euro 3 in 2007. The United States first introduced Corporate Average Fuel Economy (CAFE) regulations in 1975, which uses sales-weighted average fuel economy standards on vehicle manufacturers based on their production fleet portfolios. A suitable programme for Pakistan could also be devised for the short term in coordination with Pakistan EPA, Engineering Development Board (EDB) and local automobile, motorcycle, light commercial vehicle, bus and truck manufacturing industry associations.

## 4.13 Opportunities for Closer Sub-regional Cooperation

EE&EC is a cheap, quick, and relatively painless way for most developing countries specially the SAARC Region, to slash energy costs, stretch energy supplies, and save foreign exchange. EE&EC does not mean rationing and austerity. Rather, it aims at increasing the efficiency of energy use through waste reduction, fuel switching, and cogeneration of heat and power. By producing more output with the same energy cost input, EE&EC promotes economic efficiency and improves the productivity and competitiveness of energy consuming enterprises. In addition, EE&EC activity will help case the inevitable transition to higher energy prices since this transition will be easier for SAARC Countries that have reduced the energy content of their goods. EE&EC is also an excellent vehicle for promoting private-sector

development and can alleviate both the growing shortages of power supply and the capital constraints of building new generating capacity and other energy production and transformation units (e.g petroleum refineries). Furthermore, by decreasing energy use, EE&EC reduces energy production requirements. Which mitigates the negative environmental impacts of energy resources exploration, development, and production (e.g oil drilling, strip mining). EE&EC also reduces the atmospheric emissions from electric power plants, industrial facilities, and motor vehicles. Finally, by reducing the energy needs of economic growth and conserving depletable energy resources, EE&EC activity in the region will promotes, sustain and environmentally-sound economic growth and development. There is a need to cooperate and stressed to constitute South Asia Energy Dialogue & recommend measures to tap potentials of cooperation in energy sector to provide inputs to working group on energy. The energy experts will come up with concrete proposals for initiating sustainable projects for optimum utilization & development of energy resources. The working group on energy can discuss the following themes:

**a. <u>Reforms in the Energy sector in the region</u>**

- Exchange of reliable data information for effective energy planning
- Establishment of regulatory jurisprudence in SAARC Member States
- Regulatory law to be analyzed to assess regulatory independence
- Each government to ensure enforcement of regulations
- Carry out studies on efficacy of common energy regulator & safeguarding consumer interest & also identify procedural & bureaucratic bottlenecks in investments
- Experiences on privatization in energy sectors need to be shared
- There is need to build regulatory capacity in the region. R&D efforts in academic institutions can be organized for capacity building, also explore mutual cooperation in hydrocarbon trading

**b. <u>Energy Efficiency measures & harmonization of standards</u>**

- Task force should be set up to formulate the energy efficiency, assessment of current level of trade develop strategies & explore possibilities of harmonization
- Develop strategies for removal of barriers to promote energy efficient products
- Training & Capacity building initiatives at regional levels & regular monitoring & evaluation energy efficiency program
- Sharing of experiences on test facilities & programs among SAARC Member states establish minimum energy standards in addition to harmonization of test procedures & capability of testing facility

**c. <u>Provision of various non-conventional sources of energy</u>**

- SAARC energy centre will provide base for regional cooperation projects for government & prospective investors

- Sharing of R&D experiences among SAARC members especially on biomass, bio-fuel & hybrid technologies
- Capacity building initiatives should be taken up in the field of CDM projects development
- SAARC Members must promote renewable & co-generation energy policy

**d. Approach & principle to facilitate development of grid connectivity & gas pipelines in the region**

**i) Electricity**

- Establishment of task force to ensure common template on technical & commercial aspects
- Sharing of information on transmission parameters

**ii) Natural Gas**

- Due to shortage of gas, there is needed to approach to gas grid as for power grid. All efforts to lay gas pipeline though Bangladesh, to transport natural gas in south East Asian region and explore the option of gas supply from Middle East, central & East Asia
- Detail System & procedures should be evolved for operation, safety, and security monitoring
- SAARC members may consider joining Energy charter treaty for risk mitigation

**e. Universal access to commercial energy**

- Provisional of affordable lifetime power & fuel supply initially the cost will be provided by the government directly or through private participation
- Power supply to rural areas are not cost effective thus decentralization distributed generation (DDG) must be encouraged
- Sharing the good experience especially in the area of financial models, management practices and in basic technologies
- Collaborative R & D will brings down costs of renewable sources (solar & bio mass). Members need to develop pilot projects to understand problems & issues

**f. Development of hydro potential in the region**

- Identify large hydropower projects, to develop jointly and costs & benefits to be shared by each member state. Prospects of financial support from international financial agencies need to be explored
- Special emphasis should be laid on joint R & D efforts and comprehensive exercise in resource mapping using latest technology
- Study group may be constituted to examine the impact of climate changes, hydrological flow, glacier formation & environment on hydro potential in the region

## 5. Conclusion

Pakistan's current and forecast energy requirements development needs and resource shortages require immediate attention towards improving the efficiency of energy supply and use across all economic sectors, where much room for improvement exists. However, past attempts in this respect have demonstrated the need for a more vigorous, systematic and long term multi stakeholder approach in the future, marked by strong Government leadership and with optimal leveraging of external financers and market players. The proper design, scope and timing of such an initiative would critically impact upon the viability and competitiveness the large energy consuming infrastructure and capital accretion slated to take place in Pakistan's expanding economy over the coming decades.

Pakistan's large and complex energy sector is undergoing important structural changes and expansion as the national economy liberalizes and moves towards middle income status requiring a quantum jump in energy consumption. However, the policy institutional, regulatory and market support infrastructure for EE&EC remains weak and in many respects of nonexistent. Efficiency improvements in the recent past have largely taken place due to market drivers, such as energy prices and technological development and not due to deliberate interventions. Such a programme of coherent logically sequenced and sustained facilitative programmes and provision of a supportive environment is however, necessary for achieving the economy's true EE&EC potential within a reasonable timeframe. In addition to overall EE&EC programme and institutional capacity development there exist many opportunities for immediate medium and long term policy and technical interventions, incentives, pricing reforms and investments especially in industry, transport, buildings and demand-side management (DSM) activities. The revival of an overarching national EE&EC action plan development of requisite institutional and support infrastructure and creation of effective implementation linkages between stakeholders in major energy consuming sectors also needs to be undertaken in parallel through effective government, donor and market-based initiatives and support mechanisms.

EE programmes are universally faced with many common entrenched institutional, technical, policy, pricing, awareness and financial barriers, which Pakistan must also seek to overcome as it launches a renewed national EE&EC initiative. In particular, institutional leadership, roles, performance monitoring and capacity development have in the past stymied otherwise commendable Government efforts in this respect and require special consideration and provisioning in future plans. In particular, there is a need to understand the complexity and breathe of a national EE&EC agenda, which necessitates a multi stakeholder approach that recognizes the respective roles and strengths of many different market players working together and is beyond the capacity of any single agency on its own to deliver, as is clearly evident from the ENERCON experience. A successful long-term national EE&EC initiative will require for instance, an integration of EE in all levels of national planning and public development spending a comprehensive policy and regulatory framework energy price and utility rate setting reforms and incentives a strong equipment standards, certification and testing regime complimentary

alternative and renewable energy programmes and easy, widespread access to EE&EC specific information, financing, products and services by all categories and levels of energy market players and end-users.

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