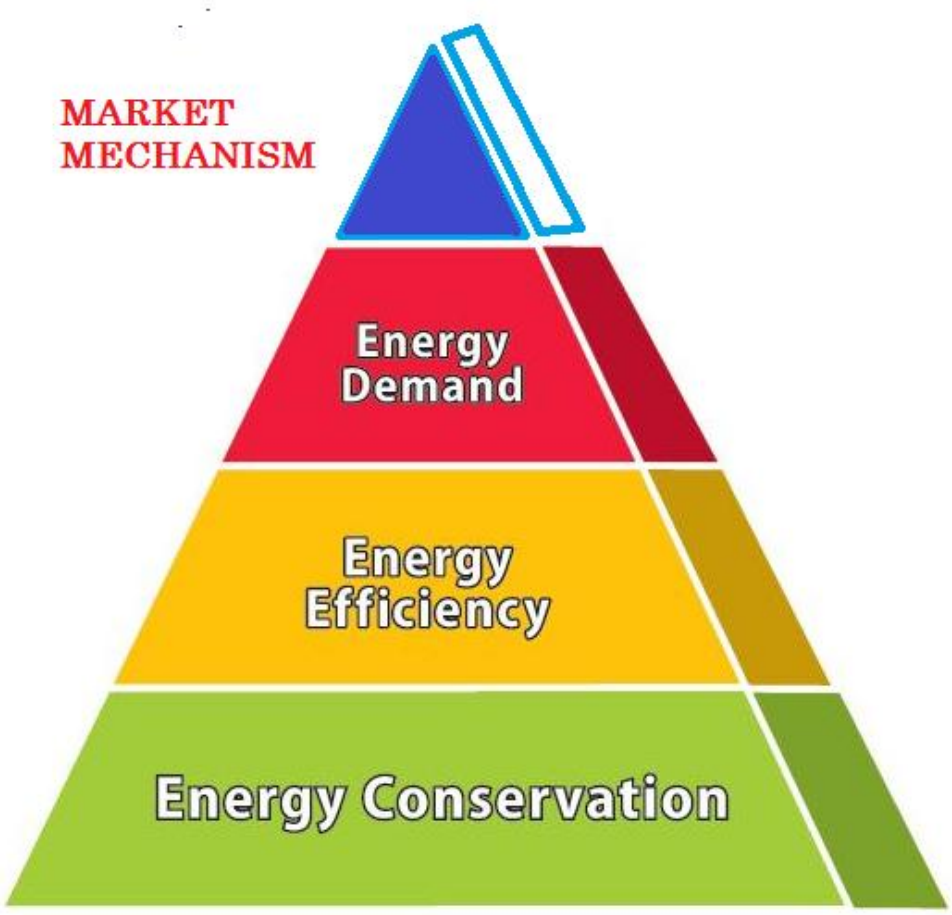
Discussion Draft

Same Energy – More Power

ENERGY EFFICIENCY & CONSERVATION

IMPLEMENTATION PLAN 2014



National Energy Conservation Centre (ENERCON)
Ministry Of Water and Power

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Preface

Energy shortages are affecting every aspect of life and economy in Pakistan. Lack of availability and interruptions in the supply of energy are affecting the business and in turn employment and other economic parameters. A number of independent evaluations have identified energy shortages as the most severe obstacle to doing business in Pakistan. The alternate / captive power generation is expensive (≈$0.20-$0.30 per kWh), thereby increasing the production costs and making the output non-competitive. A survey of 650 small and medium-sized enterprises (SMEs) in the manufacturing sector concluded that almost 80% did not intend to make new investments over the next few years, mainly because of expensive and unreliable energy supply.

In this regard the Government is making its utmost effort to increase energy supplies. However, increasing supply capacity is expensive and time consuming. Most planned / fast track power generation and natural gas supply additions are at least a few years away. Increasing supplies through conservation and efficiency improvements are thus the best, least-cost and climate-friendly way of bridging the energy gap and securing energy provision in the short and immediate run.

Energy efficiency is recognized for its effective role in meeting energy and economic challenges in a number of countries – in particular, Japan, Korea and Singapore, and can be deployed productively for addressing the energy and economic issues faced by Pakistan today. Differing from the approaches that simply expand / increase energy supply (such as building new power plants), energy efficiency decreased the demand supply gap by prioritizing actions that reduce the need for energy in the first place. Such reductions in the energy demand (without effecting productivity) can be achieved through: (a) decreasing energy losses in the supply chain - an approach commonly referred to as supply-side energy efficiency (SSEE); or (b) by increasing efficiencies of the energy consuming devices, thereby consuming less energy for the same level of service (e.g. while operating buildings, tools, products, and machinery). This strategy is known as demand-side energy efficiency (DSEE).

Energy prices in Pakistan are high and are expected to continue to increase (because of tariff rationalization and removal of subsidies), at least until such time that the present energy mix is changed to cheaper domestic resources. Properly designed and implemented DSEE programs will reduce energy expenses for all energy consumers, and are most beneficial to the end-user. Further, DSEE has been identified as the most cost effective means of reducing the global carbon dioxide (CO_2) inventory, and along with it the implied threat of climate change linked to the increased CO_2 emissions. Asia

Least Cost Greenhouse Gas Abatement Strategy (ALGAS) Study conducted for the Global Environment Fund (GEF), identified that reduction of greenhouse gases through energy efficiency improvements in Pakistan are the most economical projects, as there is a net positive return on the investments, even without accounting for the additional benefits and CDM credits associated with CO_2 reductions. In the scenario of the global fight for cleaner environment, reduction of greenhouse gases, the imminent threat of climate change and the energy shortages, Energy Efficiency today offer an opportunity to transform the character of energy service by bringing in greater sustainability, affordability, reliability and environment friendly energy at the doorsteps of every consumer.

Among the approaches of the Energy Efficiency stated above SSEE imperatives often take precedence in resource planning and related investment decisions (allocation), especially because they are bundled up and are often in the public sector. By contrast, DSEE which may require interventions at hundreds or thousands of homes, businesses, industrial sites, and government facilities, is left on its own to be managed under the market conditions in a lassie fare. Although the assignment is somewhat daunting, yet the value of DSEE cannot be ignored as it is here that lie the greatest potential for conservation, efficiency improvements and "increasing supplies" at the least cost. The end use efficiencies have been approached globally policy measures, making financing available, awareness and strict enforcement of energy efficiency standards.

Attempts by Pakistan to translate energy efficiency and energy conservation potential into realized savings have not been fully successful in the past due to financing barriers and limited political commitment. ADB conducted an assessment of Pakistan's energy efficiency situation and concluded that Pakistan needs to integrate energy efficiency into the overall energy strategy and mainstream energy efficiency into development planning and investment if the energy crisis is to be managed in the short run. Lack of financing was found to be a key barrier to energy efficiency and ADB recommended that the Government needs a flexible public sector financing mechanism to deliver priority projects in energy efficiency. These projects will result in energy savings, lower energy intensity, and increase industrial competitiveness.

ADB also noted that there is no integrated platform for energy sector strategy and policy making as the overall planning and investment approval mandate is with the Planning Commission, while the Ministry of Water and Power and the Ministry of Petroleum and Natural Resources are responsible for their respective subsectors. Energy efficiency covers multiple sectors and requires an institutional structure that is functional and effective. It is to address such concerns that the Energy Efficiency and Conservation Bill had been initiated, to strengthen enable ENERCON deliver at all levels.

In the last five years a number of interventions in the sector have been considered and a number of “programs” and “Action Plans” (costing millions of dollars as well as years of research) were prepared – some of which were also approved (signed) by the government at the time. However, due to different priorities, probably necessitated by the circumstance at the time, these program and plans were never implemented.

Key elements for a successful Energy Conservation and Efficiency Program identified in the reports prepared by various donors suggest that any successful EE program must be based on the following components: (i) EE policy and regulation, (ii) Mainstreaming the EE in the Energy and Economic decision making; (iii) Dedicated and strong institution to lead and facilitate, having the necessary political commitment; (iv) EE standards and building codes; (v) Utility based DSM market activities; (vi) Innovative financing mechanisms, (vii) Development of national, provincial and local institutional capacity; (viii) Linkages with global EE programs; (ix) EE information systems; (x) Awareness of EE means and benefits; and (xi) Recognition of EE achievers.

The current report / plan is based on the plans/reports on the subject researched, developed and approved particularly in the last five years. ENERCON has extracted and updated these reports and prepared this “plan” as a first discussion draft for consideration of the Minister for Water and Power before finalizing it. The plan looks at many economic sectors and subsectors, their economic and energy consumption patterns, the realistic energy consumption and conservation potential, the expected investments and phasing of these investments over the next ten years have been studied/updated and included in the plan.

It is imperative to realize that any energy efficiency plan can only be successfully implemented for results if there is the necessary political commitment at the highest levels and proper “enabling environment” provided for all stake holders – be it the energy suppliers, equipment manufacturers and suppliers, consumers, consultants and contractors or energy service companies (ESCOs) who will need to be facilitated and provided with the necessary enabling environment and government support / regulation.

Potential & State of Energy Efficiency in Pakistan

Pakistan's energy demand outstrips the supplies and Pakistan is facing serious challenges in bridging this gap. Yet, unfortunately Pakistanis remain most extravagant in their use of these scarce energy resources.

Friends of Democratic Pakistan (FODP) in their report in 2010 have reiterate that Pakistan's industry is energy intensive because of high energy losses, wastage throughout the value chain, and lack of investment in replacing obsolete technology and infrastructure. Their observation is corroborated by the fact that Pakistan's industry uses 15% more energy than India and 25% more than the Philippines for each dollar of GDP. Pakistan's position falls further when compared to other more energy efficient countries such as South Korea, Japan and Sweden. Low energy productivity in not just putting additional pressure on the energy situation, it is a factor affecting industrial competitiveness and the cost of doing business.

This bleak situation is appalling yet it presents an opportunity for Pakistan, as it reflects a very high potential for energy efficiency improvements in Pakistan's energy sector. According to several assessments conducted by ADB, the United States Agency for International Development (USAID), the GIZ, World Bank, Joint UNDP Energy Sector Management Assistance Program (ESMAP), HBI and JICA; 15%-25% of the total energy consumed in Pakistan can be saved using new technologies, combined with effective demand side management. These international agencies, as well as the national agencies (ENERCON and HDIP) place Pakistan's total energy savings potential at 11.16 million tons of oil equivalent (MTOE), (inclusive of savings in end uses as well as energy transformation), or 18% of primary energy use (FY2008)[1]. This corresponds to a reduction in net oil imports by half. Adjusting the ADB numbers for the current year the total energy savings potential comes up to 11.65 MTOE. The National Energy Conservation Centre (ENERCON), projects that annual energy savings of up to 25% are possible in all sectors which corresponds to approximately $3 billion/year.

[1] (a) Report and Recommendation of the President to the Board of Directors, Energy Efficiency Investment Program, August 2009.
(b) USAID Pakistan: Energy Efficiency and Capacity. http://www.usaid.gov/pk/sectors/growth/epeec.html
(c) Report of the Energy Expert Group, Integrated Energy Plan 2009-2022, March 2009

Pakistan's Energy Saving Potential[2]

Sector	Energy Consumed, FY2008		Energy Savings, FY2019	
	('000 TOE)	(TJ)	('000 TOE)	(TJ)
Domestic	8,046	355,659	2,074	91,696
Commercial	1,456	64,337	347	15,348
Industry	16,804	742,776	2,445	108,081
Agriculture	804	35,531	331	14,623
Transportation	11,567	511,297	1,906	84,224
Other Government	736	32,520	42	1,851
Subtotal, Demand Side	**39,413**	**1,742,119**	**7,145**	**315,822**
Transformation-Oil Refining			61	2,676
Transformation-Power Generation			2,121	93,763
Transformation-Gas Compression			132	5,853
Transmission-Gas Decompression			16	691
Subtotal Transformation	**16,903**	**747,131**	**2,330**	**102,984**
Total	**56,316**	**2,489,250**	**9,475**	**418,806**

Energy is the stated priority of the present government. The main focus is to increase the energy supplies at an affordable cost. For this purpose it is focusing on changing the energy mix by exploring its indigenous resources such as renewables, coal and hydro power. Focus is also on the low-cost imported fuel such as imported coal. These projects if implemented properly will reduce dependence on imported fuels and make energy – in particular the power less costly and more affordable for the people of Pakistan, However, these projects will take time to come on line, whereas energy efficiency and conservation measures are widely recognized as lower cost immediate and shorter term solution to increasing supplies and addressing the energy crisis. High energy costs (which continue to increase) and the urgent need to bridge the demand and supply gap, makes energy efficiency a high priority for Pakistan. If implemented properly, energy conservation and efficiency will reduce shortages, decrease import dependency, strengthen energy security, contribute to the environment, create jobs, and improve industrial competitiveness.[3]

[2] Integrated Energy Sector Recovery Report & Plan October 2010-ADB

[3] Asian Development Bank-Integrated Energy Sector Recovery Report & Plan October 2010

Pakistan has had a good energy conservation program, particularly in the decade of 1990. However, more recent Energy Efficiency and Energy Conservation initiatives plans failed due to lack of political commitment and financing barriers. Other reasons for dismal performance in this sector include historically low tariffs, unavailability of level playing fields, availability of expertise and the policies which have supported the "investment diversion" i.e. taking the investments away from the energy efficiency sector to the sectors which had been made more financially attractive due to the "incentives" provided to other activities by the government. The investment diversion away from the efficiency and conservation can also be attributed to the lack of government's action towards inefficiencies, standards and substandard imports. Such policies have led the consumer to shift their investments in other sectors rather than to conserve energy by shifting consumption patterns and to invest in efficient technologies.

For a private consumer, the decision to invest and obtain the returns from energy efficiency investments is based, more or less, on a trade-off between the upfront out of pocket costs verses the energy savings – i.e. the future decrease in energy expenses expected from increased efficiency. It is therefore true that higher the energy price, the more attractive energy-efficient solutions are, yet in Pakistan in spite of the fact that the electricity prices are amongst the high, the investment in efficiency is low, suggesting that there are other non-price barriers to the energy efficiency which must be addressed to obtain any meaningful success, particularly in the demand side. – Or as is better understood, on the individual consumer level.

Even on the supply side, particularly in the public sector, the generation capacity is operating with reduced output and at much lower efficiency factors compared to similar plants in other parts of the world. One reason may be inadequate and poor maintenance of the generation plants. A report by the Asian Development Bank point out that Pakistan's public sector thermal power plants are dilapidated and are operating at 25% reduced output. On the transmission and distribution networks, the systems losses are high and remain over 1/5th of the total throughput. Similarly the transmission and distribution system losses for natural-gas grid remain the highest amongst the world at about 8%. A numbers of factors are attributed to this high loss, such as aging, inefficient infrastructure, pilferage, theft, defective meters, leakages, inefficient compression[4] in gas utilities and unmetered supply.

Both Power and Gas utilities are focused more (may be as a result of political pressures) on the system expansion rather than efficiency improvements. Their investments / financing available for the efficiency and system improvements are therefore diverted to the system expansion. The Oil and Power regulators do set the efficiency targets but due to shortage of financing, these energy utilities are postponing

[4] Replacing inefficient Gas compressors by the Gas Companies could double the compressor efficiency but the same is not being done by the gas companies due to lack of financing.

investments in improving system losses and preferring investments in system expansion. If one was to invest in the efficiency improvements, possible energy savings in transformation, transmission, and distribution by FY2019 are estimated at 2.3 MTOE[5]

The conservation and efficiency improvement potentials on the demand side are also great. Households in Pakistan account for about half of total electricity consumption. Lighting and air conditioning in the summer are the main drivers of peak loads. Inefficient household and inefficient appliances therein cause a huge burden on the already strained supply. Demand-side energy savings potential is estimated at 7.1 MTOE which corresponds to 17.7% of all energy consumed in the country.

According to the ADB, Some of the Energy Efficiency and Conservation actions in various sector of economy that can bring relief to the current crisis are:.

In the agriculture sector which accounts for 11.1% of the demand for electricity (0.696 MTOE), 94.5% of the demand for light diesel oil (LDO) (0.12 MTOE) in the country, and High-speed diesel (HSD) 13.90% (1.1 MTOE) substantial energy savings can be realized. A large amount of demand in agriculture is because of the widespread use of tube wells throughout the country. There are more than 1.2 Million tube wells in Pakistan, of which about 25% are grid connected with a connected load of about 3000 MW. According to estimates approximately 38% of the electricity consumed by electric pumps in the agriculture sector can be saved by replacing the existing inefficient Pump sets (electric motors and pumps) with more efficient (locally available) pumps. In the same manner LDO and HSD consumption can be decreased by up to 50% (without compromising the outputs) by replacing the low efficiency pump-sets used in the tube wells run by diesel generators.

Although the savings are significant and have a relatively quick payback, yet the farmers are indifferent and not motivated to bring in these efficiencies by investing in new / efficient equipment and in its maintenance. Lack of this motivation is attributed not only to the lack of awareness / information / education on the subject, but also because the power supply to the tube-wells is already subsidized and some tube wells are connected to the grid without a meter. Unless there is a charge per unit of usage, one cannot expect any meaningful energy efficiency or conservation activity, a major barrier in water pumping efficiency improvements is the limited access of the farmers to the capital required for the purchase of high efficiency tube wells, motors and generators. The plan is to remove these barriers by providing improved access to credit and promoting awareness on the benefits of efficient pumping technologies. ENERCON considers it an important area of intervention in the short to medium run. In view of the significant potential for saving energy and recognizing the constraints faced by farmers; ADB has calculated the investment requirements for replacing older

[5] Sustainable Energy Efficiency Development Program - ADB

inefficient tube wells with new, efficient once. In this regard an action plan for replacing 20,000 older inefficient tube wells with new, more efficient configurations within the next 3 years requiring an investment into the sector amounting to about $100 million was proposed and approved by the Government in 2011 but awaits implementation.

Similarly in the building sector, which account for 40% of energy use in most countries, lie the greatest potential for cost-effective energy savings through efficiency improvements. However, implementation / realization of such potential is low because of barriers such as split incentives between tenants and landlords, lack of awareness of efficient technologies, nonstandard products in the market, absence of qualified technicians, and high initial investment costs. It is because of these reasons (barriers) that the market- driven energy-saving measures have not come in place in the Pakistan economy in any significant way.

Many developed and developing countries have mandatory energy efficiency standards for new dwellings and service buildings. The Philippines and Singapore were among the first to establish standards followed by many other countries. ENERCON had prepared the Building Energy Code of Pakistan in 1992, along with a compliance handbook detailing technical design and material data. However, the actual compliance to the code was negligible, due to the fact that the code was not “mandatory” but “voluntary” and there was hardly any awareness activity to get the code accepted by the municipalities. More recently, ENERCON and the Pakistan Engineering Council (PEC) have come up with a new revised code for the commercial buildings. As new buildings represent a small share of the existing stock, the code will have a gradual impact in the short term but will, however, become significant in the longer term. Many countries including India have extended regulations to existing buildings and have introduced energy efficiency certificates for them each time there is a change of tenant or a sale. These certificates enable people to obtain information about the energy consumption of the homes that they are going to buy or rent. Such certificates could be an effective tool to implement incentives such as tax credits or low interest rate loans for owners who increase the energy performance of their buildings via refurbishments. Standards for new buildings may also have an indirect impact on the technologies, material, and practices used in retrofitting old buildings.

As an immediate action the Government plans to launch the Building Energy Code and follow it up with regulations in order to ease residential energy demand by reducing heating, air conditioning, ventilation, and lighting costs. The code will be regularly reviewed and the standards reinforced as new technologies become available and socio- economic parameters improve.

Lighting load in Pakistani households is significant and as it represents 15% of peak evening demand. It is estimated that there are more than about 50 Million light points fitted with inefficient incandescent bulbs with a maximum peak load more than 3,000

megawatts (MW) consuming as much as 4,140 gigawatt hours (GWh) annually. A domestic lighting baseline survey was performed in March 2009 and found that 37 million incandescent light in the 40–100 watt range contribute at least 2,028 MW to the system's peak. Incandescent Bulbs in households were consuming as much as 4,140 GWh annually. Average daily load curves showed peak demand on the power grid starting at 5 p.m. in the winter and 7 p.m. in the summer and lasting approximately 5 hours in both cases.

Government of Pakistan has recently launched a program to replace 30 million Incandescent Bulbs with compact fluorescent lamps (CFLs). The project is at a distribution stage, and is expected to reduce the peak demand by at least 1,100 MW, and more than 2,000 GWh of electricity is expected to be saved once the distribution is complete. Considering upstream losses and reserve margin requirements, the project is capable of saving $1.84 billion in investments for 1,600 MW in newly installed peak generating capacity that would otherwise be required in the next two years. The purpose of highlighting this project is to stress the kind of savings that are possible in the Energy Efficiency improvement projects. As a follow up of this project the government is considering phasing out incandescent bulbs altogether, thereby bringing in even larger savings through domestic lighting efficiency improvements. Similar projects are being considered for street lightings and outdoor commercial lighting.

Just like improvements in lighting efficiency, the house hold sector offers tremendous energy saving opportunities that can be realized through replacing the inefficient home appliances with the efficient ones. Program to facilitate such a transition to make new technologies commercial and through raising the consumer awareness and supporting financial mechanisms need to be encouraged. According to the best estimates 38% of electricity consumers in Pakistan have refrigerators (with 67% improvement potential), 38% have water pumps (50% improvement potential), and 15% have air conditioning (with 40% improvement potential). Of the total residential electricity use, 47% is from appliances used for space cooling. Other appliances such as water pumps, televisions, and computers account for the remaining 36% of electricity used. Estimates[6] point out that the energy-saving potential in household electrical appliances is as high as 6,100 GWh by 2019.

The Energy Efficiency and Conservation Plan focuses on refrigerators and air conditioners, since they account for a large part of household electricity consumption. As soon as the Energy Efficiency and Conservation Legislation is approved and enacted, a program to improve the (performance) energy efficiency of new appliances either by imposing a minimum energy efficiency rating or by removing the least-efficient products from the market will be initiated. Labeling programs would provide the

[6] Technical Assistance Consultant's Final Report for "Pakistan: Sustainable Energy Efficiency Development Program "(Project Number: ADB TA 7060-PAK), August 2009.

consumers with information that enables them to compare the energy efficiency of various appliances in the market. The information would help consumer change his/her selection criteria (buying decision) on the basis of energy consumption of household appliances and thereby the “Life Cycle Cost” and not just the initial cost.

Just as in other sub-sectors, energy efficiency and conservation activities will not be limited to Power (electricity) savings alone, as there is a great potential for natural gas saving through efficiency improvements in the domestic sector. In the residential sector, 21% of natural gas is consumed for the provision of hot water. Hot water geysers in Pakistan are inefficient and offer a remarkable potential for gas savings. According to the estimates from Sui Northern Gas Pipeline Ltd (SNGPL) 42,241 Million Standard cubic feet (MMScf) of gas is used annually for heating water. Gas utilities have already devised such retrofits for existing appliances, for a project cost of $30 million, which can save up to 800,000 MTOE of gas annually.

As can be seen there are opportunities to improve efficiency, conserve and make available the least cost energy in every sector and area of energy use. However, in order to achieve it, it will be necessary to have, in addition to the required financial mechanisms, the strengthening of the institutions responsible for formulating, planning, implementing, and monitoring energy efficiency plans and practices in Pakistan, such as ENERCON – which should be strengthened and be made responsible to govern the energy efficiency and conservation affairs having the capacity and capability to work across sectors to help mobilize and influence broader stakeholders on the energy efficiency initiatives, planning activities, and policy framework with sufficient direct interaction and reporting to key government decision makers, especially within the energy sector.

Similarly the Planning Commission needs strengthening to effectively exert and prepare realistic strategic plans & policies and monitor effectively the Public and Private sector programs particularly with regards to the flow of investments in the sector. For this purpose, the proforma (PC-1) for infrastructure sectors development projects need to be updated to include energy efficiency cost effectiveness analysis and other energy efficiency measures. Also in order to effectively implement the standards and labeling program the capacities of the Pakistan Standards and Quality Control Authority which is the national standardization body under the Ministry of Science and Technology (MOST), needs additional resources and institutional capacity to undertake this task.

Whereas a number of institutions are assigned to work in the area of energy conservation & efficiency, they lack capacity and the legislative mandate to achieve the desired objectives with regard to Energy Efficiency and Conservation. These institutions need to be developed, given the powers, their capacities enhanced and they be required to deliver their mandates. Energy efficiency programs usually require a dedicated technical body able to reach a range of stakeholders such as companies,

local authorities, or nongovernment organizations and ensure coordination with authorities (international, national, regional). Further, energy efficiency is recognized as the fastest way to address the issues of pollution and climate change and bring in the CDM revenues into the country. In this respect, ENERCON is the apex institution and both its administrative and technical capacities need to be strengthened and the organization be held responsible for the formulation, implementation, and monitoring of energy efficiency plans and practices and for governing energy efficiency and conservation policies, as well as those environment program related to energy efficiency and climate change.

Finally to enable a legal environment for energy conservation in the public and private domains, a framework for an energy efficiency law is needed. In this respect, the government will be promulgating an energy efficiency framework law which is expected to include provisions for codes, standards, energy reporting, labeling, testing, mandatory audits, fines and incentives, and monitoring and compliance mechanisms at various levels. Moreover, a process for monitoring the implementation of such measures would be built in and will assign the responsible / authority to undertake the monitoring once the legal cover and standards are in place to enable the delivery of measurable energy saving to the country.

Although a number of mechanisms have been tried, a most successful win-win-win model is that of the Energy Service Companies (ESCOs). ESCOs invest on the basis of the saving potential of the clients and get their return on the basis of “Shared Savings”. What it means is that the ESCOs guarantee a certain level of savings and charge the customer according to the amount that has been saved – ensuring that the returns are linked to the project performance. There are a number of ESCOs in Pakistan, however, their effectiveness need to be increased through joint demonstration projects by the public sector. In order to derive the maximum from ESCOs incentive packages for ESCOs and increased awareness regarding the energy performance contracting as well as trust in ESCOs will be required. These can be achieved by the enactment of ENERCON law, and other mechanisms such as bundling of smaller projects; co-financing targeted areas of potential; creating guarantee funds for ESCOs; standardizing contract procedures; and measuring, verifying, and developing accreditation systems.

Accelerating Energy Efficiency Activities in Pakistan

Energy efficiency has not been a priority in mainstream policy development in the sector. As a result, Pakistan's energy intensity is high. It uses 15% more energy than India and 25% more than the Philippines for each dollar of its gross domestic product. There are high transmission and distribution losses in the power system estimated at about 22%, and of the remaining more than half is lost in a number of inefficient appliance being used by the consumer today. The gas sector is similarly inefficient, with over 8% line losses in the system. Further, at the end-use, the efficiency of the boilers, room and space heaters and other appliances account for another 25% -30% loss due to their inefficiencies and misuse including ignored maintenance. Improving efficiencies and reducing waste will make available the saved energy for alternate uses and at the same time reduce the overall energy bill of the consumer. The icing on the cake is that energy saved through DSEE improvements or conservation is often 5-20 times cheaper than the new energy and such projects are most cost effective having highest economic return.

Demand Side Energy Efficiency (DSEE) management, therefore, deserves at least the same attention that for new power generation. Asian Development Bank, acting as a secretariat for the Friends of Democratic Pakistan prepared a report titled “Integrated Energy Sector Recovery Plan”, defined a roadmap to eliminate the energy deficit in the short run, and placed DSEE and SSEE on top of the list that Pakistan could do in the short run. Similarly, but separately, the ADB developed a document for MYFF on energy Conservation and Efficiency Investments. Deriving from these documents and the inputs from other donors it is clear that if the Energy Efficiency and Conservation is not mainstreamed there is little hope of achieving even a fraction of the possible savings. Following the mainstreaming of Energy Efficiency in the national economic, energy and procurement policies, a longer term plan can be implemented with specific measurable targets and financing on a fast track basis.

The donors have also indicated the steps necessary to mainstream the Energy Efficiency and Conservation in the Energy policy which are:

(a) Pass an energy efficiency framework law to strengthen the legal foundations of energy efficiency;

(b) Dedicate a single apex body to oversee implementation of the energy efficiency law and be responsible for the overall efficiency & conservation matters of the country.

(c) Strengthen the related institutions

(d) Accelerate standardization and labeling of electrical appliances according to energy use; and adopt building energy code.

(e) Immediately start a targeted awareness campaign through the focal point.

(f) Include the energy efficiency in the approval processes of the project by including a section in the PC-1's and also ensuring the provision / requirements in the Government procurements.

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Mainstreaming Energy Efficiency into Energy Policy

	Action/Project	Objective	Responsibility	Timeline	Financing	Output Indicators
1	Pass energy efficiency framework law Strengthen capacity of apex body Considered Energy Efficiency in Project approvals and procurement	Enable legal and administrative framework to ensure sustainability of Energy efficiency and conservation programs and policies	National Assembly, on proposal of government Federal Government for strengthening ENERCON, PSQCA, PCSIR and Energy Wing of Planning Commission	March 2014 Continued activity starting March 2014	$2 m	• Energy Efficiency law passed and published by March 2014. • Apex institution fully staffed and fulfilling its mandate by March 2014. • PC-1 Approvals to include EE. PEPRA Rules to allow for EE procurements.
2	Expand broad public awareness campaign Foster education on energy efficiency by including it in school curricula Annual energy efficiency week.	Increase awareness and mobilize mass support for Energy Efficiency and Conservation	ENERCON MWP/ MPNR/PEPCO/ DISCOs/Ministry of Education	By July 2014 and ongoing July 2014	$2.7 m $5 m	• Higher demand for energy efficiency measures evidenced by a larger number of ESCOs certified by December 2014. • Curricula updated by July 2015. • Energy Efficiency week held annually starting 2014.
3	Launch Stipulate Building Energy Code Adopt Standards and labeling Strengthen PCSIR	Easing energy demand	Apex body(ENERCON) Ministries of Industries, Environment and Housing, PSQCA, PCSIR,PEC	by December 2014	$8.5 m	• Building energy code developed by February 2014 and made mandatory over the next 3 years by December 2016. • Labeling of major electrical appliance completed by December 2015.

1. Policy and Regulatory Framework (1/3)

Objective	Impact	Performance	Measurement	Time Frame	Agencies
1.1 Legislation: Legislative support and operational rules to support energy efficiency policy and regulatory environment	Provide legal basis for efficiency related regulation, standards, and policy implementation	Access of all citizens to energy efficiency products, services, and information, irrespective of location and income Elimination of substandard and inefficient energy consuming stock in all economic sectors Incorporation of efficient practices and procurement in all development planning and public investments Removal of barriers to energy efficiency investments and service by the private sector Reduced peak loads and smoothing out of power demand profiles through DSM and end-user behavior changes Reduced system losses in all forms of energy supply and delivery Market transformation towards the manufacture, import, and sale of efficient energy consuming Equipment, appliances, and devices	Energy efficiency -specific additional legislation and regulations (e.g., appliance standards and labeling, T&D performance levels, dispersed generation and net metering, building energy code, vehicle fitness and emission standards,etc.) General and sectorial energy use surveys and census conducted periodically and established database of industrial, transportation, agricultural, and buildings energy statistics Mandatory public sector procurement, performance, and investment requirements in EE across federal, provincial, and local governments	Draft Law presented to the Assembly – March 2014 Other activities Commensurate with timelines given above beginning June 2014	ENERCON through Ministry of Water and Power

1. Policy and Regulatory Framework (2/3)

Objective	Impact	Performance	Measurement	Time Frame	Agencies
1.2 Policy: Implement Immediate, medium and long term EE policy and planning actions	Remove fiscal burden of high energy cost Achieve energy security through optimal energy mix and balanced demand and supply Alleviate energy crisis, particularly electricity and gas 'load shedding". Reduce energy waste and high peak demand Increase energy productivity and economic competitiveness Reduce intensity of energy use per unity output across economic sectors and improve per capita energy access Sustained transformation into an environmentally friendly, low-carbon economy Establish climate resilient infrastructure	Identify and remove existing anomalies and contradictions in policy and regulatory framework Remove barriers, impediments, and bottlenecks to energy efficiency investments, service and product delivery, and informed consumer behavior Integrate energy efficiency into planning, and decision making in both public and private sectors Formulate mandatory public sector energy efficiency investments, procurement, and operational practices Undertake low- /no-cost policy measures to encourage energy efficiency and conservations	National energy efficiency policy coordination and implementation mandate streamlined into the Planning Commission Revised PC-1 proforma, and evaluation guidelines explicitly including energy efficiency and clean energy aspects into all public investments 10-year National Energy Efficiency Action Plan with quantified targets, milestones, institutional roles annual work plans and mandatory public sector energy efficiency actions Energy tariffs rationalized to reflect economic cost of service provision and sectoral cross subsidies removed Effective phase-out of specific inefficient devices (GLS, mercury vapor streetlamps, two-stroke motorcycle engines, substandard domestic gas appliances, etc.)	Draft: March 2014 Final: June 2015 ECNEC Approval: June 2015 Mandatory provisions to be continuously reviewed and updated Phase-out program design: September 2014 Supportive actions and legislation: June 2014	Lead Agency ENERCON ,With relevant stakeholders Relevant line agencies

1. Policy and Regulatory Framework (3/3)

Objective	Impact	Performance	Measurement	Time Frame	Agencies
1.3 Regulations: Develop effective regulatory framework and remove barriers, anomalies, set performance standards, and facilitate energy efficiency investments	Increased public and private investment in energy efficient technology and practice Reduced wastage of energy	Improved energy standards amongst suppliers, major endue segments, and equipment. Reduced energy production, transportation and transformation losses Reduction in stock of inefficient and obsolete products, technologies, and installations Increased local production, manufacturing, support, and consumer market for energy efficiency products and services ENERCON takes the role of “facilitator” particularly for ESCO related activities.	National energy efficiency standards, certification, and labeling for domestic and commercial equipment / appliances Upgraded and expanded industrial EE requirements for major equipment (boilers, motors, HVAC, etc.) Certified ‘green’, passive, and zero-energy buildings Accredited energy performance testing and certification facilities and procedures Definition of EE equipment and product categories for fiscal exemptions and surcharges on inefficient alternatives Energy audits and implemented energy efficiency measures in public and private buildings and Industries – directly or through ESCOs	MEPS for lighting: June 2014 MEPS for domestic and office electric appliances: June 2014-June 2016 MEPS for domestic gas appliances: September 2014 -15 Vehicle fuel efficiency, traction, and emissions (Euro I-IV) standards: September 2014 - 2016 Other standards and regulations (street lighting, ToD tariffs, net metering, fuel quality/composition, standby consumption, etc.) : December 2014 onwards Industrial equipment standards and certification program: Dec 2014-June 2016 Revised Building Energy Code and building certification criteria: April 2014 Testing protocols, facilities, and labeling schemes: Initiated January 2015 onwards GoP notifications: Starting July 1, 2014 Program implementation: Starting June, 2015	Lead Agency ENERCON in association with: PSQCA,PC PSQCA,PC PSQCA,OGRA, SNGPL/SSGC PC,PSQCA,Pak EPA Municipalities, NEPRA, OGRA, PSQCA,PEPCO/DISCOs,OCAC PSQCA, EDB, FPCCI PC, PSQCA & Donors.

2. Economic Evaluation and Planning (1/3)

Objective	Impact	Performance	Measurement	Time Frame	Agencies
2.1 Analysis: Evaluate energy savings potential in each major economic sector, corresponding EE investment requirements, and associated financial costs, returns, and economic benefits	Meaningful targets, investments, and financial support directed towards cost-effective energy efficient technology deployment and market development	Realization of economically viable savings in energy supply, delivery, and use Prioritization of high payback energy efficiency investments and identification of optimal long-term development strategies	National EE investment plan for 2015-2025 Incorporation of EE evaluation results into national integrated energy planning and optimal supply mix Planning commission to integrate Energy Efficiency section in the PC-1s	July 1, 2014 (reviewed annually) April 2015 (updated Annually on a 3 year revising basis)	ENERCON through Ministry of Water and Power; Planning commission; Ministry of Finance

2. Economic Evaluation and Planning (2/3)

Objective	Impact	Performance	Measurement	Time Frame	Agencies
2.2 Costing and financing: Determine incremental and avoided costs of EE deployment, including public and private investments in upgrades, retrofits, replacements, and additional procurement, and related program management, communications, and impact evaluation mechanisms	Adequate budgetary provisions for additional Up-front financial costs of EE investments and mandatory procurement, and program development. Cost-sharing and financing of EE investment support amongst government, private sector, and IFIs	Determination of subsidies, rebates, surcharges and other fiscal support justified for EE facilitation Development of incentives and ready financing for EE investment by relevant government administrations and agencies, public and private industry and transportation, SMEs, ESCOs and individual consumers Establishment of dedicated EE funds and lines of credit in commercial and non-profit financing organizations Allocation of EE investment and operational provisions in annual PSDP and government agency budgets	National Industrial EE financing facility utilizing commercial banks and SME financing institutions operationalized Annual disbursement levels of EE-related loans, grants, and carbon financing through domestic and international agencies Specific policy, financial, and fiscal incentives notified by the GoP for manufacture, import, and provision of EE products and services	Pilot: June 20114-15 Full-scale: March 2015 Annual reporting: Starting September 2015 Beginning June 2014 (reviewed and updated annually)	Ministry of Water and Power; Planning commission, Ministry of Finance

2. Economic Evaluation and Planning (3/3)

Objective	Impact	Performance	Measurement	Time Frame	Agencies
2.3 Planning: Integrate least cost EE options in national energy planning based on lifecycle payback accounting and set targets for annual EE related actions and investments	Mainstreaming of EE in national development planning to realize national and global benefits Transition of economy towards more sustainable, indigenously fueled, and low-carbon development track Improved global competitiveness of local industry and exports	Enhanced productivity of energy use and reduction of waste and losses Improvement in environmental conditions and reduced pollution levels caused by energy use and increasing industrialization Reduced volatility and impact of energy supply/demand shortfalls, quality of service, and prices	Reduced national energy intensity in terms of GDP output/energy consumed Reduced carbon footprint of economy in terms of CO_2/GDP output emissions Increased annual budgetary outlays for EE-specific activities by both public and private sector Growth in market demand and sales of EE-related products and services Increased affordability and access to modern energy services by lower income and marginalized population segments Increased utilization by country of international carbon financing and realization of credits associated with clean energy development	Annual intensity data reporting: Beginning Year 2015 Annual emissions data reporting: Beginning 2014 EE specific annual budgetary provisions: Beginning FY2014 Annual reporting by DNA of CDM registrations and CER/VER awards: Beginning FY2014 December	ENERCON ,HDIP, PC,Pak EPA Climate Change Division Various manufacturer, trade and sales associations, Customs (FBR)

3. Project Implementation (1/3)

Objective	Impact	Performance	Measurement	Time Frame	Agencies
3.1 Investment climate: Increased private sector participation in EE investments, upgrades, manufacturing, and services	Energy efficiency market Transformation, Improve business confidence in EE investments, as well as incentives to encourage behavioral change amongst end-users Enhanced national technical and industrial base for EE servicing, manufacturing and technology sales	Improvement in installed base and accumulation of efficient energy consuming stock in all categories (industrial equipment, vehicles, buildings, appliances, etc.) and enhanced production, transport and transformation efficiency for primary energy supplies in power, gas, and oil products Gradual indigenization and expansion of local EE system and component manufacturing, technical services, and financing options	Significant replacement/ban of IBs by quality CFLs and FTLs in commercial and residential buildings Replacement of inefficient domestic gas cook stoves, space and water heaters with efficient variants Establishment of commercially viable ESCO operations Increased sales of major EE upgrade and replacement technologies (e.g., certified industrial equipment, controllers, insulation, diagnostic and tune-up equipment, building retrofits, etc.) Installed CHP capacity in industry, high-pressure boilers/cogeneration in sugar mills	Beginning in March/April 2014	ENERCON to play the coordinating role. PEPCO/DISCOs, retail outlets, MoF, FBR SNGPL/SSGC, retail outlets, multilateral programs (GEF, CDM,etc.), MoF Private sector, bilateral assistance (EPEEC) and relevant stakeholders.

3. Project Implementation (2/3)

Objective	Impact	Performance	Measurement	Time Frame	Agencies
3.2 Public energy efficiency programs : EE based procurement	Immediate and institutionalized energy efficiency upgrades and savings Creation of guaranteed market for EE products and services Enhanced awareness of EE technologies and options across relevant sectors and demonstration of payback opportunities	Design and financing of mandatory and voluntary public EE spending, including industrial audits and upgrades, building and lighting retrofits, vehicle fleet tune-ups, streetlight replacements, and equipment standards Public- and donor-funded energy efficiency facilitation, promotion, deployment, and technical assistance programs, including targeted rebates and subsidy	Specific itemized allocation for EE-related programs and spending in the National Budget Guidelines, criteria, and procedures for ensuring energy efficiency in all major public sector expenditures, acquisitions, and practices Number, type, capacity, and location of specific public energy efficiency programs	Beginning FY2015 onwards (revised annually	Ministry of Water and Power, Ministry of Finance, PPRA and ENERCON

3. Project Implementation (3/3)

Objective	Impact	Performance	Measurement	Time Frame	Agencies
3.3 Support infrastructure: Facilitation of EE service implementation and delivery	Availability of physical and institutional support required for EE project implementation and assimilation into national economy	Provision of up-to-date data and information on energy efficiency options, technologies, sources, savings, vendors, financing, and benefits to all energy stakeholders in an organized, reliable, and freely accessible (i.e., online, free-of-cost, verifiable, etc.) basis Creation of technical and management capacity within major energy stakeholder groups and categories as well as provision of such services to individual end-users on demand	Numbers of industrial and building energy audits and energy end-use surveys undertaken Number of vehicle diagnostic and tune-up stations established EE codes, standards, and labeling schemes developed and implemented EE testing and certification facilities set up EE/DSM cells and EMPs established in major energy supply and user agencies System-wide T&D upgrades undertaken in power and gas T&D and associated loss Reductions Numbers of ESCOs and energy efficiency related businesses, information services, and educational and training programs institutionalized Penetration and price/quality range of energy efficiency products and technological solutions in domestic market (e.g., CFLs, thermal insulation materials, control devices, etc.)	Assessed and reported: Starting September,2014 (updated annually)	ENERCON, FPCCI, EDB, private sector OMCs PSQCA, PCSIR, with IFI Support NTDC, DISCOs, SNGPL, SSGC, bilateral assistance (USAID EP-EEC, etc.) Various manufacturers, trade and sales associations, Customs (FBR)

4. Institutional Strengthening (1/2)

Objective	Impact	Performance	Measurement	Time Frame	Agencies
4.1 Capacity Building of Focus agencies: **ENERCON, Ministry of Water and Power, Energy Wing PC**	Enhanced EE-based project evaluation capacity Inclusion of efficiency options in integrated energy modeling and planning process Establishment of EE based public sector investment and procurement planning and approval processes Collection and dissemination of EE and energy-use related data and information Investment Promotions Technical Training Certificate Update Regulation Pilot Demonstration	Streamlined and integrated coordination and implementation of the national energy efficiency policy and programs Reduced energy consumption profile of public sector development and operational expenditures Improved institutional mandates and service delivery in energy sector planning ,management and regulations EE-specific policy, regulatory, and technical advice to GoP Improved inter-agency coordination in EE planning, options analysis, and program development Greater liaison with private sector and consumers on demand side energy management	Full and competent status of ENERCON Institutional and project reports on EE-related activities, targets, and expenditure Short- and medium-term energy efficiency business operational plans for focus agencies developed and approved	June 2014 Starting January 1 or July 1, 2015 Reviewed and revised annually, with periodic external performance monitoring	Ministry of Water and Power, ENERCON, Ministry of Finance and Donors.

4. Institutional Strengthening (2/2)

Objective	Impact	Performance	Measurement	Time Frame	Agencies
4.2 Capacity Building of Other relevant agencies and stakeholders: regulators, private businesses and financial sector, NGOs, etc.	Increased awareness and participation of market stakeholders in the energy efficiency planning and investment process	Clear enunciation of institutional roles, plans, facilities, rules, instruments, activities, etc., relevant to energy efficiency developers and end-users	Activity reports, notifications, publications, and services offered by key organizations Establishment of accredited quality and performance testing, certification, and labeling protocols and facilities Creation of associated retrofit, replacement, and disposal mechanisms for obsolete/hazardous stock	Periodic Commensurate With timeline for Regulations Program specific, beginning with CFL waste management in June 2014	ENERCON to coordinate. Relevant stakeholder Agencies PSQCA, PCSIR, private Sector Relevant agencies identified in respective program design

5. Market Facilitation (1/2)

Objective	Impact	Performance	Measurement	Time Frame	Agencies
5.1 Energy auditing and technical advisory services	Identification of viable energy efficiency options, lowering of market risks for EE investments, and promotion of EE-related sales and services	Creation of EE survey, assessment, and implementation support capacity for servicing private and public sector requirements	Number of industrial and commercial building audits conducted Number of energy use surveys undertaken in different sectors Regular publication of energy use and EE related data and information in the public domain	Continuous, ongoing Institutionalized Surveys beginning in FY 2014-15	ENERCON, ESCOS, Private Sector

5. Market Facilitation (2/2)

Objective	Impact	Performance	Measurement	Time Frame	Agencies
5.2 Information and technical knowledge dissemination: Highlight savings potential, other benefits, and business opportunities in energy efficiency	Improved EE data and information access amongst all energy sector stakeholders	Identification of efficient technologies, best practices, benchmarks, financial and economic gains in all economic sectors	Directory of available online EE information, publications, ESCOs, and consultancy Firms	Beginning 2014	ENERCON stakeholders
	Greater awareness of EE investment options and returns for informed decision making by producers, suppliers, and consumers	Optimization of energy resources utilization though optimal mix of resources (including renewable and alternative fuels), technologies, and operational methods	Establishment of dedicated technical, financial, and management advisory services, including manuals, operational guidelines, standards, and comparative indices	Beginning 2015	
			Creation of EE-specific curricula, training, and research programs in secondary and tertiary educational institutions and vocational centers	Beginning 2015	

6. Technical and Financial Support Mechanisms (1/2)

Objective	Impact	Performance	Measurement	Time Frame	Agencies
6.1 Coordination & implementation of donor assistance	Better utilization of existing and planned multilateral and bilateral technical assistance and funding of EE programs in country, including carbon financing opportunities	Increased levels and effectiveness of international assistance for energy efficiency projects, capacity building, and technology assimilation Improved project design-to implementation procedures and timelines Better coordination and consolidation of common activities and goals, and reduced duplication and fragmentation of capacity development	Extent and levels of IFI funding and disbursement for energy efficiency programs Regular donor coordination meetings on energy efficiency under ENERCON / Ministry of Water and Power / EAD lead Consolidation of external financial and technical assistance into annual energy efficiency Action Plan work plans and targets Institutionalized program reporting, monitoring, impact analysis, and follow-on and support requirements Energy driven group establishment	Bi-Annual reporting: Beginning 2014	Ministry of Water and Power, ENERCON, EAD, donors, consultative committee ,bilateral donor agencies

6. Technical and Financial Support Mechanisms (2/2)

Objective	Impact	Performance	Measurement	Time Frame	Agencies
6.2 Develop EE Financing opportunities and instruments	Ready access to EE equipment, marketing, and consumer financing on par with other commercially established sectors	Increased availability of local commercial, donor, and public financing for EE-related expenditures, equipment, projects and programs across end-user spectrum (large industries to domestic households) Establishment of performance based ESCO contracting and SME and micro financing for small and individual energy consumers	Level of commercial and public financing (loans, grants, subsidies, etc.) and lending for EE applications Numbers and sizes of EE projects qualifying for carbon credits under CDM	Financing data reporting: Beginning FY2015 Annual reporting by DNA: Beginning Year 2015)	ENERCON, Relevant EE financing programs, funds, IFIs, LFIs, Climate Change Division (DNA)

7. R&D Technology Transfer and Commercialization (1/3)

Objective	Impact	Performance	Measurement	Time Frame	Agencies
7.1 Market surveys and potential assessment	Updated evaluation of energy using stock, uses, load profiles, quality and standards, prices, commercial availability, knowledge and perceptions for improved energy efficiency related decision-making and planning by relevant stakeholders	Targeted assessment and geographical focus based on preliminary assessment of resource-wise potential	Periodic surveys of industrial, commercial, transportation, agriculture, buildings, and households focusing on energy use applications and patterns Reporting of EE-relevant information and data in relevant publications (e.g. Energy Yearbook) Generic energy audit summaries and energy efficiency potential assessment studies Consumption profile and DSM activity information on utility websites Resource directories of EE standards, benchmarks material and equipment performance, vendors and suppliers, services, prices, and associated paybacks	Beginning 2014 (updated every two to three years)	ENERCON to be the custodian and coordinator

7. R&D Technology Transfer and Commercialization (2/3)

Objective	Impact	Performance	Measurement	Time Frame	Agencies
7.2 Indigenous fabrication and marketing	Improved and expanded local EE/RE products, materials, fabrication, manufacturing, and servicing	Access of local energy users to state-of-the-art EE technology, upgrade and retrofit options, and best international experience	Technical collaboration agreements, technology licenses, joint-ventures, etc, between local and international industry partners Targeted training programs in product and process upgrades, standards compliance, waste management, marketing, etc	Continuous, ongoing Continuous, ongoing	ENERCON, FPCCI, relevant industry Associations, etc. with international TA support programs.

7. R&D Technology Transfer and Commercialization (3/3)

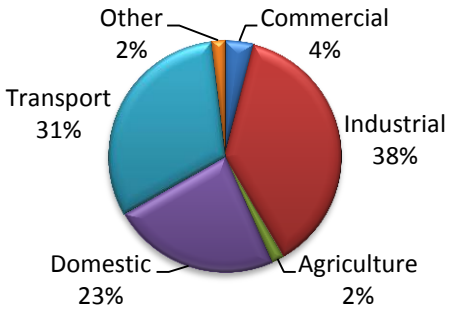
Objective	Impact	Performance	Measurement	Time Frame	Agencies
7.3 R&D and technical training	Enhanced capacity to implement and service efficiency improvements in all energy consumer categories	Improved and efficient Technology assimilation, commercialization of certified EE products, and increased numbers of trained manpower in related technical skills	Numbers and outputs of energy efficiency-related technical training programs, workshops, courses, etc. Indigenously designed and modified upgrades, materials and retrofit options, improved technical and performance parameters and certification of local products, new patents, etc.	Reporting beginning 2015 (updated annually)	ENERCON,FPCCI, HDIP, MoI, with NEPRA

A. ENERGY EFFICIENCY PLAN FOR THE RESIDENTIAL SECTOR

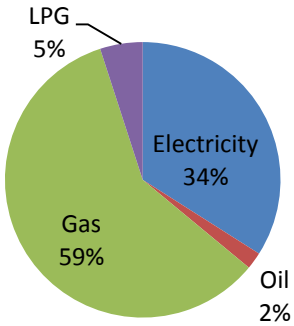
The residential sector in Pakistan consists of over 27 million households that account for 23.4% of the total commercial energy consumption use in the country. 20.3% of natural gas fuel is consumed in the domestic sector and about 27% of households in the country have access to piped natural gas. Electricity is available to about 70% of the households which consume about 46.4% of the total eclectically consumed.

In FY2013, electricity consumption in the residential sector was 35,617 GWh. with almost equal consumption in lighting, cooling & general appliance. Hagler Bailly Pakistan (HBI) had estimated 36,29,35% respectively as calculated for lighting, cooling and general appliances for 2008, on the basis of appliances, their type and electricity use per appliance. In absence of a new survey, it is assumed that the electricity consumption continues in the same ratio for the current year

Total Energy Consumption FY2011-12:[7]
40.03 MTOE



Residential Sector Energy Consumption in FY 2008: 8.05 MTOE[8]



[7] Pakistan Energy Year Book 2011-12

[8] Sustainable Energy Efficiency Development Program-(ADB) 2009

As of 30th June, 2012; there are approximately 19.6 million electrified residential customers in Pakistan at present[9].Table A-1 gives a distribution company(DISCO) wise breakup of the total residential customer base. In Pakistan, promoting the most efficient technologies available and providing incentives to the market to make new technologies commercial will be crucial to slowing down and reversing the trend in the electricity consumption of households.

Table A-1 Distribution of Residential Consumers by DISCO (2011-2012)

PESCO*	IESCO	GEPCO	LESCO	FESCO	MEPCO	HESCO	SEPCO	QESCO	KESC
2,761,232	1,882,619	2,258,940	2,808,748	2,712,234	3,888,629	718,422	552,110	394,843	1,659,766
Total Consumers (PEPCO +KESC) 19,637,543									

- **Including TESCO**

Significant savings in electricity consumption can be achieved by replacing incandescent bulbs (IB's) in the domestic sector with energy efficient CFLs that provide the same lumen output at lower wattage levels and have a longer lifetime. The Government of Pakistan has already launched the 30 million CFL distribution program for all consumers, which is expected to save about 1200 MW, by replacing inefficient incandescent light bulbs.

ENERCON has developed a Nationally Appropriate Mitigation Action (NAMA) Proposal for energy efficient lighting in residential, commercial, industrial and outdoor sectors which refers to a set of policies and actions that Pakistan can undertake as part of a commitment to reduce greenhouse gas emissions. NOC has already been given by Ministry of Water & Power for submitting it to different donor agencies.

The transition to Energy Efficient Lighting in the Residential, Commercial, Industrial and Outdoor Sectors of Pakistan would result in the reduction of 1.97 million tonnes of CO_2 annually while also reducing SO_2 and mercury emissions as Non-GHG emissions. Annual energy savings would be 4.06 TWh, 5.46% of total national electricity consumption and 35.1% of lighting electricity consumption. Annual savings would be approximately USD 408 million.[10]

Labeling programs should provide consumers with information that enables them to compare the energy efficiency of various appliances on sale. Pakistani institutions should aim at changing the selection criteria of consumers by drawing their attention to the energy consumption of household appliances. In the residential sector; fans, air conditioners, refrigerators, motors and compact florescent lamps (CFLs) consume significant amount of electricity. The description of few of the appliances is given below:

[9] State of the Industry Report 2012- NEPRA

[10] Source: Country Lighting Assessment UNEP (en.lighten Project) 2010-11

Electric Alternating Current (AC) Fan is one of the major electric energy consumers among the domestic appliances in Pakistan. There are about 450 small and medium scale enterprises engaged in production of fans for domestic and export market. Pakistan fan industry focuses on low price consumer fans. Approximately 8.0 million fans are produced annually in Pakistan with an estimated value of PKR.20 billion. Pakistan's exports are mainly concentrated in low income markets such as Africa, Bangladesh and some Middle East countries.

A sizeable energy saving potential is available in fans which can be captured through energy conservation and efficiency initiatives like implementation of Energy efficiency Standards and Labeling (ES&L) regime. According to ENERCON estimate[11], there are approximately 55.3 million fans being used in Pakistan which consume 15-20% of domestic electricity demand and possess an energy saving potential of about 1200 MW if replaced with energy efficient fans.

Like electric fan, air conditioner is also one of the major energy consuming electric home appliances. During the year (2011-12) the production of Air Conditioners and Refrigerators increased by 5.39 percent as compared to the corresponding period of previous year. This trend is recently increasing due to rising living standards in several countries combined with a cost reduction of AC products. This tendency is contributing to an increase in greenhouse gas emissions.

As many as 180,778 air conditioners were produced during July- April (2011-12) against the production of 171,535 units during July- April (2010-11), according to the data of Pakistan Bureau of Statistics (PBS).The growth in production of air conditioners and equally growing demand, including imports of air conditioners, has necessitated introduction of energy conservation and efficiency measures for air conditioners in order to reduce the burden on energy resources and to limit the drainage of electricity through inefficient air conditioners.

According to ENERCON survey there is more than 03 million population of split type air conditioners in Pakistan which are rapidly replacing the window type air conditioners (Higher energy consumer than split type).Still more than 500 MW of energy saving potential is envisaged in split type air conditioners which needs to be taped through appropriate energy saving and efficiency measures including use of energy efficient refrigerants and ban on use of CFC refrigerants.

Refrigerator/freezer are high energy consuming electric home appliance in Pakistan. An estimated population of 13 million refrigerators has been reported in the country. According to PBS data, the production of refrigerators/freezers also increased by 6.5% during the recent years. There are about ten major local manufacturers of international brands of refrigerators/freezers like Philips, General, Orient and National etc. Besides local manufacturing, refrigerators are also imported from abroad with capacity of 9.0 Cu. Ft to 13.5 Cu. Ft.

[11] Development of Energy Efficiency & Labelling Program GIZ – May2010

Refrigerator of above mentioned capacity annually consume an estimated average energy of 620 KWh and there is a saving potential of 1300 MW envisaged in the available population in Pakistan which can be exploited through appropriate energy conservation and efficiency measures as per ENERCON study. Strict ban on use of inefficient CFC refrigerants may be one of the measures.

Table A-2 Energy Consumption, Realizable Savings, Investment Requirements & Schedule for Replacing Electrical Appliance

Energy Type	Energy Consumed, FY 2011-2012		Energy Consumption Forecast by 10 Years		Energy Efficiency Potential[12]	Realizable Savings FY 2019		Investment Required	Simple Payback Period (Years)	
	(GWh)	(MTOE)	(GWh)	(MTOE)	Effective	(GWh)	(MTOE)	(Million)$	Fin.	Eco
Refrigeration	5,732	0.466	10,550	0.859	54%	3,095	0.266	304	1.5	1.6
Water Pumping	1,602	0.130	2,933	0.238	40%	641	0.055	465	10.9	12.2
Air Conditioning	7,406	0.602	13,631	1.110	32%	2,370	0.203	149	0.9	1.0
Fans	12,818	1.040	23,565	1.919		-	-	-	-	-
Others	8,032	0.653	14,765	1.202		-	-	-	-	-
Total	**35,590**	**2.897**	**65,444**	**5.329**		**6,106**	**0.525**	**918**		

Table A-3: Year Wise Phasing of Investment Required

($ Million)

	Year 01	Year 02	Year 03	Year 04	Year 05	Year 06	Year 07	Year 08	Year 09	Year 10
Annual	-	9.2	55.1	165.2	266.2	247.9	128.5	36.7	9.2	
Cumulative	-	9.2	64.3	229.5	495.7	743.6	872.1	908.9	918.0	918

[12] Sustainable Energy Efficiency Development Program-Asian Development Bank (ADB) 2009

B: ENERGY EFFICIENCY PLAN FOR THE AGRICULTURE

Agriculture is the backbone of Pakistan economy, which contributes 21.4 percent to GDP, employs 45 percent of the country's labor force and contributes in the growth of other sectors of the economy[13]. Inefficient farm and cultivation practices contribute to low levels of productivity. Most of the energy consumed in agriculture is for the operation of water pumps for irrigation and tractors for soil preparation and haulage of agricultural supplies and products. Commercial energy use in the sector is increasing, with increasing farm mechanization and adoption of energy based technologies.

Energy used in the agriculture sector includes electricity, LDO and HSD.[14] Electricity is used only for the operation of tube wells (turbine pumps), whereas LDO and HSD are used to operate both tube wells and tractors. Agriculture accounts for 11.5% of the demand for electricity and 94.5% of the demand for LDO in the country.[15]

Table B-1: Energy Consumption in Agriculture Sector[16]

Unit: TOE

	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	ACGR
Oil*	101,406	113,889	72,710	60,499	42,294	24,271	-24.9%
Electricity	665,861,	689,948	716,297	789,095	730,636	696,122	0.9%

***HSD connection for tractors in agriculture sector is not separately available and is included in the transport sector. Agriculture sector represents LDO only**

The above table shows a declining trend of LDO usage in agriculture sector, which is not understandable, but can be attributed to the unaccounted for and non-documented imports from across the borders. According to an estimate by the Ministry of Petroleum, the government loses Rs. 5 to Rs. 6 Billion tax revenue annually due to smuggled petroleum products.

The Table B.2 shows the number of tube well connection during the year 2012 and the corresponding energy consumed reflecting the seasonal trend.

Table B-2: Electric Tubewells & Their Energy Consumption 2012[17]

Month	12	11	10	9	8	7	6	5	4	3	2	1
Number of Tube wells / Consumers	294,479	293,477	292,241	291,180	289,636	288,311	286,287	284,972	283,962	282,639	281,657	280,850
Electricity Sold / Consumed (MWh)	560,063	623,260	742,994	673,162	879,730	881,595	753,150	703,699	659,849	704,545	615,728	567,557

Tube wells operating in Pakistan can be divided into three categories; electric, diesel engine- operated, and others. Both diesel and electric pump sets are used in

[13] Pakistan Economic Survey 2012-13.
[14] LDO used only for tube well operations.
[15] Integrated Energy Sector Recovery Plan & Report October 2010
[16] Pakistan Energy Year Book 2012
[17] Data Extracted from Power Information Technology Company (PITC) database

Pakistan for irrigation pumping applications. The efficiency of these engines depends on their loading, speed, quality, design, and fabrication. Centrifugal lift pumps are mostly used in the Indus plains to raise groundwater for irrigation. The energy consumption of the pump depends on its operating speed—for a given pump; there is an optimum speed which yields maximum efficiency. Small and low-speed pumps operate best at about 1,500 rpm.

For low-speed diesel engines that are generally coupled to run at about 500 rpm, a transmission system is required; the simplest and cheapest method for this is by running a transmission belt between two pulleys of different sizes. Belt transmission systems often cause losses due to flapping and slippage of the pulley wheels. When belts are correctly fitted, the efficiency of the transmission system should be 85 to 90 percent. With direct coupling systems, the efficiency can be as high as 95 percent for high-speed engines and motors operating at higher speeds, and can be coupled directly to the pumps.

Operated in an appropriate manner, the efficiency of the pumping system can exceed 80%, but can drop to 50% at incorrect and partial loads. Engine manufacturers in Pakistan typically claim a diesel fuel consumption of 0.33 liters per kWh (0.25 liters per horsepower-hour) of shaft power, which is equivalent to about 30% efficiency. These estimates are based on laboratory tests under field conditions. The best efficiency expected of a poorly-loaded engine is approximately 25 percent; with a poorly maintained engine, this could drop to as low as 10 to 15 percent.

As with diesel engines, the efficiency of electric motors used to derive pump sets also depends on loading. Operating at the rated load, the motor's efficiency should be between 80% and 90%. This efficiency drops with the capacity of motors used. For high quality motors, at 75% of rated capacity, efficiency drops by about 10% from full load efficiency. For motors with poor quality windings and incorrect insulation, the efficiency of the electric motor could be as low as 54%. These poor quality motors are prevalent in Pakistan, especially among motors that have been locally rewound and repaired. In addition, many of the locally manufactured motors exhibit very poor power factor ratings throughout their operating range.

Direct energy use in irrigation can be influenced in two basic ways: increasing the efficiency of pump systems used and reducing the quantity of water required for irrigation. The irrigation pumping subsector was analyzed by HBI on the basis of new and existing diesel and electric pump sets. Energy savings were computed on the basis of increasing the efficiencies of existing and new electric pumps from current estimated efficiency of 21.6 percent to a new of 35.7 percent, and from the current 5.4 percent to 10.1 percent. It should be noted that these efficiency improvements represent a conservative estimate of the average achievable improvements.

The electric motors and diesel pump market in the country is dominated by relatively inexpensive, locally manufactured, inefficient equipment. Generally, since farmers are quite price-conscious, it is expected that the current market share of locally-

manufactured equipment is unlikely to change, keeping additional energy savings potential in this respect unaffected to 2019.

According to agricultural experts and manufacturers of high efficiency pumps, motors, and engines, approximately 38% of the electricity consumed by electric pumps in the agriculture sector can be saved by replacing existing electric motors and pumps with more efficient ones available locally. Similarly, LDO and HSD consumption can be reduced by up to 50% by replacing the existing low efficiency pump sets used in the tube wells.

Farmers in Pakistan, however, have limited access to capital and are therefore severely constrained in making cash investments required for the purchase of high efficiency tube wells. These barriers can be removed by improving access to credit and promoting awareness on the benefits of high efficiency pumping technologies. In view of the significant potential for saving energy and recognizing the constraints faced by farmers, investment requirements for the replacement of older inefficient tube wells with new, more efficient configurations have been estimated assuming 50% replacement of the existing equipment over a period of ten years. Investment requirements, investment schedule, and estimated payback periods for electric motors and diesel engines are indicated in Table b-3 and b-4 respectively.

According to the plan prepared by the Asian Development bank and accepted by the Government of Pakistan, more than 3400 GWh can be saved by improving the efficiencies of the existing tubewells. Such a program is expected to cost about US $93 Million with a payback of less than 6 months.

Table B-3 and B-4 details the investment requirements and the saving expected through improved tubewell efficiency.

Table B-3: Energy Consumption, Realizable Savings, Investment Requirements and Schedule for Tubewells[18]

Energy Type	Energy Consumed, FY 2011-2012		Energy Consumption Forecast,FY2025		Energy Efficiency Potential	Realizable Savings FY 2025		Investment Required	Simple Payback Period (years)	
	(GWh)	(MTOE)	(GWh)	(MTOE)	Effective	(GWh)	(MTOE)	(Million $)	Fin.	Eco.
Electricity	**8547**	**.696**	**17948**	**1.46**	**19%**	**3410**	**.277**	**93**	**0.4**	**0.4**

Table B-4: Year Wise Phasing of Investment Required

										($ Million)
	Year 01	**Year 02**	**Year 03**	**Year 04**	**Year 05**	**Year 06**	**Year 07**	**Year 08**	**Year 09**	**Year 10**
Annual	-	0.9	5.6	16.8	27.1	25.2	13.1	3.7	0.9	
Cumulative	-	0.9	6.5	23.3	50.4	75.6	88.7	92.4	93.3	93.3

[18] Sustainable Energy Efficiency Development Program-Asian Development Bank (ADB) 2009

C. ENERGY EFFICIENCY PLAN FOR SUGAR INDUSTRY

Pakistan ranks fifth in the world in terms of area under sugar cane cultivation, eleventh by production, and sixtieth in yield. The sugar industry of Pakistan is the second largest agro-based industry in the country. As sugarcane cannot easily be transported over long distances, the sugar industry is mostly located in Punjab and Sindh provinces near areas where the sugarcane is cultivated. Sugarcane farming and sugar manufacturing contribute significantly to the national exchequer in the form of various taxes and levies.

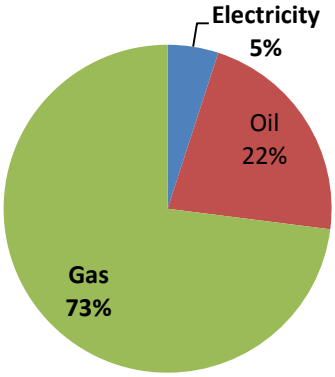
Sugar mills in Pakistan are currently using bagasse, a renewable fuel produced as a by-product in the sugar manufacturing process, inefficiently in low-pressure, 23 bar based power system, whereas other countries have abandoned low-pressure boilers and switched to boilers of 60 bar and above in high-pressure cogeneration power systems. Resultantly, sugar mills in Pakistan are still unable to produce meaningfully surplus electricity for export to the grid.

Sugar mills in the country generally operate for 120 days during the winter months from November through April. Pakistan's power generation capacity is at the lowest during these months due to water and gas shortages. Additional power generation through a local renewable biomass fuel will not only help the country reduce its chronic power shortages during this critical period but also save precious foreign exchange spent on import of furnace oil. Furthermore, efficient use of a biomass fuel like bagasse is environmentally friendly and would help mitigate greenhouse gas emission from the country's power sector.

Sugar production is a seasonal activity, due to which sugar mills operate on average for four months a year. Bagasse production is 32% by weight of the total sugar cane crushed, of which 70% is utilized as fuel in boilers. The rest is sold to other industries, such as pulp paper and board manufacturers as raw material.

As per Asian Development Bank (ADB) report the sugar industry at the time had a share of 2% in the total commercial energy consumed by the industrial sector in Pakistan, utilizing natural gas as its main energy source (Figure C.1). Of the total energy consumption of the industry, 73% was in the form of natural gas and 5% electricity supplied by public utilities, while the remaining 22% was fueled by oil.

Figure C-1: Energy Consumption in the Sugar Industry 2008[19]



The savings potential for commercial energy utilized by the sugar industry is negligible. However, there is a significant potential for upgrading the mills to save the bagasse generated as a byproduct of the cane crushing process from being burnt as fuel for boilers, and instead utilizing it for the generation of power for export to the electricity grid. As explained above, approximately 70% of the bagasse produced is consumed by the sugar industry itself.

Bagasse consumption of sugar mills can be reduced by 42% by introducing efficient replacement fuels for heating purposes. And this 42% savings of bagasse in the sugar factories can be used for power generations **Table C-1** gives details of the potential for exporting bagasse-based power to the sugar industry.

Table C-1: Power Generation Potential from Bagasse (2011/12)

Total cane crushed (FY2011-12)[20]	48,038,612	Tonnes
Total bagasse production	15,372,355	Tonnes
Bagasse consumed by the sugar industry	10,760,649	Tonnes
Bagasse available for power generation	4,611,706	Tonnes
Heat content of bagasse	9.6	MJ/kg
Efficiency (Co-generation)	60%	
Power generation	7,093,512	MWh

The total electricity generation potential from bagasse is estimated at 3,547 GWh without co-generatiom.

According to the AEDB estimates 2000-3000 MW can be generated through Sugar Mills Bagasse in 2-3 years if the correct policy is in place, subsequently a new bagasse based on co-generation policy has been developed and necessary documentation has been approved by ECNEC.

[19] Source: Sustainable Energy Efficiency Development Program-Asian Development Bank (ADB) 2009
[20] Pakistan Sugar Mills Association Annual Report, 2011-12.

Asian Development Bank is however more conservative in its assessment of the total power production possible from the sugar mills and suggest that about 675-775 MW can actually be brought on line in the next 3 years at a price of $2,073/kW, corresponding to the capital cost of a steam-cycle power plant operating on coal. Table C-2 and C-3 gives the investment requirements, investment schedule and the estimated payback period of the power 675-775 MW power generated in the sugar mills from bagasse.

Table C-2: Investment Requirements and Schedule for Export of Bagasse-Based Power by the Sugar Industry[21]

Electricity Generated		Investment Required	Payback Period
(GWh)	(TOE)	($ Million)	(Years)
3,547	506,994	1,609	5.1

Table C-3: Year wise Phasing of Investment Required

($ Million)

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Annual	-	16	97	290	467	434	225	64	16	
Cumulative	-	16	113	402	869	1,303	1,528	1,593	1,609	1,609

[21] Sustainable Energy Efficiency Development Program-Asian Development Bank (ADB) 2009

D. ENERGY EFFICIENCY PLAN FOR THE TEXTILE SECTOR

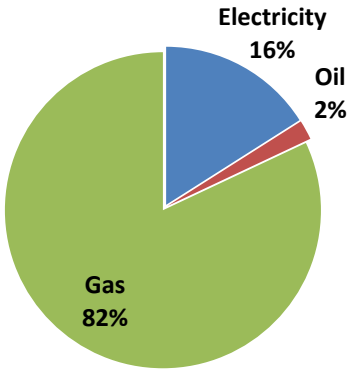
Textile Industry, a pivotal part of Pakistan economy contributing 52% to the country's exports has immense potential for growth and development. The Table d-1 shows the Textile Industry's Economic Contribution in 2011-2012. The main products of the textile industry include cotton yarn, cotton cloth, cotton products, garments, hosiery, blended and synthetic cloth. At present more than 500 mills are operating in the country.

Table-D-1 Economic Contribution by Textile Industry's 2011-12[22]

Exports	52% of total exports (US $ 12.36 Billion)
Manufacturing	46% of total manufacturing
Employment	40% of total labor force
GDP	8.5% of total GDP
Market Capitalization (Listed Companies)	5.0% of total market capitalization

The textile industry accounts for 17% share in total industrial energy consumption, utilizing electricity and natural gas as its main energy sources (**Figure D-1**). Of the total energy consumption of the sector, 82% is in the form of natural gas and 16% is electricity supplied by public utilities. The remaining 2% is oil, which is utilized as a backup energy source to natural gas. 70% of the total electricity requirement of the textile sector is met by natural gas-based 'captive' generation, and the remaining is supplied by the power utilities WAPDA and KESC. End-use of energy varies, depending on the industrial processes involved. Although these are the numbers for 2008-9 (the best number available), they can be used for this report as no significant investment has gone in the sector for Energy Efficiency.

Figure D-1: Energy Consumption in the Textile Industry: 2.9 MTOE



[22] Pakistan Economic Survey, SBP, TDAP

Table D-2 lists the areas with potential for energy efficiency improvement in the textile industry.

Table D-2: Energy Efficiency Improvement Potential in the Textile Industry[23]

Thermal Energy Savings

1. Boiler replacement 2. Boiler tune-up and water treatment 3. Improved design of steam distribution systems 4. Insulation of bare steam lines 5. Steam traps and condensate recovery 6. Improving efficiency of heaters 7. Waster heat recovery from stenter and oil heater exhaust 8. Waste heat recovery from wash water	
Total Thermal Savings	**22%**

Electrical Energy Savings

1. Improvement of electrical distribution systems 2. Use of natural daylight 3. Use of high efficiency reflectors in lighting systems 4. Replacement of standard motors with high efficiency motors 5. Rewinding of electrical motors using standard specification wire 6. Use of electronic motor controllers (‘soft’ start)	
Total Electricity Savings	**7%**

Most of the textile industry in the country is privately-owned, and operates in a competitive local and international market environment. There are no public subsidies provided on the energy used by the industry, and the industry procures fuel at market prices from local sources. As a result, manufacturers focus on optimizing energy use. Almost a third of the textile mills have been set up or modernized over the last seven years, and therefore, a proportion of the installed equipment of the total industry is of recent vintage and efficient. Energy savings are achievable for a realizable fraction of 50% on account of the constraints and issues in achieving a higher technical energy saving potential discussed earlier.

Based on estimates available from industry surveys, investment requirements have been estimated assuming a 1.5-year payback of the total investment required to upgrade gas-based equipment, and a 2.5-year payback of the total investment required to upgrade electricity-based equipment. Based on these payback periods, the average investment requirement per

[23] Sustainable Energy Efficiency Development Program-ADB

mill is estimated at $0.4 million. It is assumed that future expansion and additions in the textile industry will be based on efficient technology, and therefore there no additional savings potential is assumed for the future.Investment requirements, investment schedule, and the estimated payback periods for implementing energy efficiency in the textile industry are indicated in Table D-3 and D-4 and Table D-5 and D-6 for natural gas and electricity, respectively. The total investment required for upgrading equipment utilizing natural gas as fuel is about $67 million. Similarly, the total investment required for upgrading equipment operating on electricity is about $42 million.

Table D-3: Natural Gas Consumption, Realizable Savings, Investment Requirements and Schedule for the Textile Sector[24]

Energy Type	Energy Consumption Oil and Gas Consumed, FY2008	Energy Consumption Forecast,FY2019	Energy Efficiency Potential	Realizable Savings FY 2019	Investment Required	Simple Payback Period	
	(MTOE)	(MTOE)	Effective	(MTOE)	(Million)$	Fin. (Yrs)	Eco. (Yrs)
Natural Gas	**2.519**	**5.1**	**11 %**	**.277**	**67**	**1.5**	**0.9**

Table D-4: Yearwise Phasing of Investment Required

										($ Million)
	Year 01	**Year 02**	**Year 03**	**Year 04**	**Year 05**	**Year 06**	**Year 07**	**Year 08**	**Year 09**	**Year 10**
Annual	-	1	4	12	20	18	9	3	-	-
Cumulative	-	1	5	17	37	55	64	67	67	67

Table D-5: Electricity Consumption, Realizable Savings and Schedule for the Textile Industry

Energy Type	Energy Consumed, FY 2008		Energy Consumption Forecast,FY2019		Energy Efficiency Potential	Realizable Savings FY 2019		Investment Required	Simple Payback Period	
	(GWh)	(MTOE)	(GWh)	(MTOE)	Effective	(GWh)	(MTOE)	(Million)$	Fin. (Yrs)	Eco. (Yrs)
Electricity	**5318**	**.433**	**10768**	**.876**	**4%**	**212**	**.017**	**42**	**2.5**	**2.9**

Table D-6: Year Wise Phasing of Investment Required

										($ Million)
	Year 01	**Year 02**	**Year 03**	**Year 04**	**Year 05**	**Year 06**	**Year 07**	**Year 08**	**Year 09**	**Year 10**
Annual	-	1	2	7	12	11	6	2	1	-
Cumulative	-	1	3	10	22	33	39	41	42	42

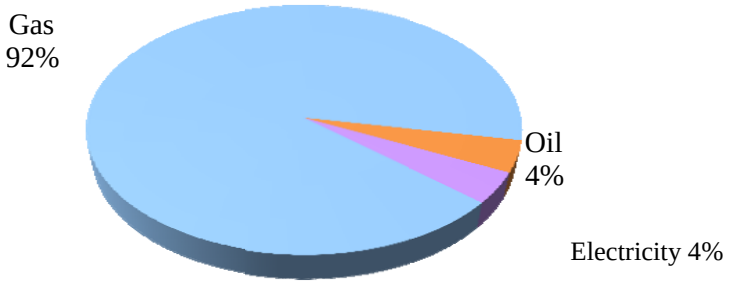
[24] Sustainable Energy Efficiency Development Program-Asian Development Bank (ADB) 2009

E. ENERGY EFFICIENCY PLAN FOR THE PAPER INDUSTRY

Paper Industry of Pakistan is not among the prime industries of the country and is still at developing stage. Consumption of Paper in Pakistan exceeds the domestic capacity and there is heavy reliance on imports. The production of paper products in Pakistan is based mainly on local grass and wheat straw, which constitute about 46% of the basic raw materials used for this purpose, followed by waste paper at 29%. About 10% of the input consists of imported pulp, which is used for the production of specialty grade products. Other raw materials used are bagasse, rice straw, and cotton linter[25]. The Pakistani pulp and paper industry consists of over 44 manufacturing units of various products and capacities[26], ranging from 20 to 120 tonnes per day. The paper industry in Pakistan is mainly located in the provinces of Punjab and NWFP.

The paper industry has a share of 7% in total industrial energy consumption in Pakistan, consisting mainly of electricity and natural gas in terms of inputs. Of the total energy consumption by the sector, 92% is in the form of natural gas, 4% is electricity, and 4% is oil-fueled.

Energy Consumption by the Paper Industry



Energy consumed paper industry is for the following processes:

(i) Pulping
(ii) Bleaching
(iii) Rolling.

Pulping involves the thermo-mechanical conversion of wood chips into pulp, and is therefore the most energy-intensive of these processes. However, specific energy consumption per tonne of paper produced varies with the quality of paper being manufactured. Therefore, the

[25] Energy Conservation Database and Sectoral Energy Use Diagnosis', RCG/Hagler Bailly, Inc
[26] Census Manufacturing Industry 2005-06, Federal Bureau of Statistics.

end-use of energy by process varies with the product quality. With the exception of a few large paper producers, the industry does not utilize energy efficient technologies, such as cogeneration and energy recovery from waste streams.

Table below lists the areas with Potential for energy efficiency improvements in the Pakistan Paper Industry

Areas with Energy Efficiency Improvement Potential in the Paper Industry

Thermal Energy Savings	
i.	Efficient use of natural light
ii.	Insulate bare steam and condensate lines
iii.	Recover flash steam from paper machines and use in pre-dryers
iv.	Improving efficiency of boilers and water treatment
v.	Recover blow steam from one digester to pressurize another
vi.	Co-generation
Total Savings in Thermal Energy	**10%**

The total energy savings potential for natural gas in the Pakistan paper industry is estimated to be 169,621 TOE by year FY2019 in the sector.

Almost a third of the paper mills are operated in line with international standards and benchmarks. The savings are therefore estimated at a realizable potential factor of 70%, which accounts for the proportion of industry that is not currently operating at efficient levels.

The average investment requirement per mill is estimated at $0.75 million. Considering the small scale of much of the paper industry, it is assumed that future expansion patterns will likely continue with existing inefficient technologies, therefore keeping realizable savings unchanged till FY2019. Table E-1 and E-2 indicates investment requirements, investment schedule, and the estimated payback periods for energy efficiency improvements in Pakistan's paper industry.

Table E-1: Energy Consumption, Realizable Savings, Investment Requirements and Schedule for the Paper Industry[27]

Energy Type	Energy Consumption Forecast,FY2019	Energy Efficiency Potential	Realizable Savings FY 2019	Investment Required	Simple Payback Period	
	(MTOE)	Effective	(MTOE)	(Million)$	Fin. (Yrs)	Eco. (Yrs)
Natural Gas	**2.42**	**07%**	**.169**	**70**	**2.0**	**1.2**

Table E-2: Year Wise Phasing of Investment Required

										($ Million)
	Year 01	**Year 02**	**Year 03**	**Year 04**	**Year05**	**Year 06**	**Year 07**	**Year 08**	**Year09**	**Year 10**
Annual	-	1	4	13	20	19	10	3	1	-
Cumulative	-	1	5	17	37	56	66	69	70	70

[27] Sustainable Energy Efficiency Development Program-Asian Development Bank (ADB) 2009

F. ENERGY EFFICIENCY PLAN FOR THE IRON & STEEL INDUSTRY

The iron and steel industry in Pakistan consists of about 650 steel mills of different sizes, with a total product output of 4.6 million tonnes. The annual demand for iron and steel products in Pakistan has been in the range of 5 million tonnes recently, resulting in a gap between demand and installed capacity that is met by imports. Of the installed capacity, Pakistan Steel Mills in the public sector accounts for 1.1 million tonnes, with the remainder in the private sector.

Steel mills in the private sector mainly consist of induction furnaces that utilize scrap metal and steel rerolling mills.The most efficient production technology available in the iron and steel industry is the direct reduced iron (DRI) technology, which is being introduced to the country by Tawarqi Steel Mills presently under construction near Karachi. The steel industry in Pakistan utilizes energy in the form of electricity, gas, and fuel oil, in which there is a savings potential mainly in gas and electricity use. The consumption of electricity and gas by the country's steel industry is presented in **Table F-1**.

Table F-1: Electricity and Gas Consumption by the Iron and Steel Industry[28]

Iron and Steel Industry	Electricity (GWh)	Gas (MMscf)
Private Sector*	2,704	9,472

*Excluding Public Sector

Induction furnaces installed in the private sector use electricity as an energy source. These furnaces have an average specific electricity consumption of 650 kWh/tonne. Based on an analysis of a typical production unit provided by industry experts, there appears to be scope for reducing this consumption by 8% to 600 kWh/tonne, with an $8.8 million investment for the entire industry. Consumption of natural gas is mainly in the rerolling process that has an efficiency improvement potential of 20%, requiring a total investment of $8.1 million for the industry as a whole. Electricity is used in the rerolling process to drive the motors, blowers, overhead cranes, and other equipment, and has a savings potential of 36% that can be achieved with a total investment of $8.1 million.

The potential for improving energy efficiency lies mainly in the private sector steel industry. The private sector steel industry in Pakistan predominantly consists of small- and medium-scale production units, where the penetration of energy efficient technologies is relatively low. Furthermore, their businesses mainly depend on the procurement of raw materials, marketing of products, and relatively high labor costs,

[28] Sustainable Energy Efficiency Development Program-Asian Development Bank (ADB) 2009

particularly in the rerolling industry where the level of automation is low. Energy does not account for more than 20% of the production costs. However, in view of attractive returns on energy efficiency investments, it is estimated that 50% of savings identified can be realized.

Table F-2 shows electricity consumption and savings potential in this sector, followed by Table F-3 which provides the gas consumption and savings potential.

Table F-2: Process-Wise Electricity Consumption and Savings Potential in the Private Sector

Iron and Steel Processes	Energy Consumption Electricity (GWh)	Energy efficiency potential	
		Technical	Realizable
Melting	2,275	8%	4%
Re-rolling	429	36%	18%

Table F-3: Process-wise Gas Consumption and Savings Potential in the Private Sector[1]

Iron and Steel Processes	Energy Consumption Gas (MMscf)	Energy Efficiency Potential	
		Technical	Realizable
Re-rolling	9,472	20%	10%

Based on an evaluation of current plans, it can be assumed that future expansion in the iron and steel sector will be based on more efficient technologies and therefore there will be no realizable additional energy savings potential for new capacities added in the future. **Table F-4 and F-5** and **Table F-6 and F-7** present details of energy savings and investment schedules for electricity and gas, respectively, in the private sector iron and steel industry of Pakistan.

ENERCON strongly feels that expanding and replicating the best practices will greatly help industries in attaining efficiency, particularly in the steel sector (being one of the highest energy intensive sectors) in the following key areas:

- **i.** Modification of furnace zones
- **ii.** Modification of waste heat recovery
- **iii.** Modification of combustion system
- **iv.** Ceramic fiber insulations
- **v.** Ultra low cement cast able hearth
- **vi.** Introduction of control system
- **vii.** Modification with energy efficient electrical equipment (Transformers, Variable frequency drives (VFD's), Pumps, Blowers, lighting etc)

Table F-4: Electricity Consumption, Realizable Savings and Schedule for the Private Sector Steel Industry[29]

Energy Type	Energy Consumed, FY 2008		Energy Consumption Forecast,FY2019		Energy Efficiency Potential	Realizable Savings FY 2019		Investment Required	Simple Payback Period (Years)	
	(GWh)	(MTOE)	(GWh)	(MTOE)	Effective	(GWh)	(MTOE)	Million US $	Fin.	Eco.
Melting	2,275	.185	4,606	.375	4%	88	.007	8.8	1.1	1.3
Re-Rolling	429	.034	869	.070	18%	78	.006	8.1	1.2	1.4

Table F-5: Year Wise Phasing of Investment Required for Electric Energy Efficiency Improvement in the Steel Sector

										($ Million)
	Year 01	Year 02	Year 03	Year 4	Year 05	Year 06	Year 07	Year 08	Year 09	Year 10
Annual	-	0	1	3	5	5	2	1	0	-
Cumulative	-	0	1	4	9	14	16	17	17	17

Table F-6: Natural Gas Consumption, Realizable Savings and Schedule for the Private Sector Steel Industry

Energy Type	Energy Consumption FY2008	Energy Consumption Forecast,FY2019	Energy Efficiency Potential	Realizable Savings FY 2019	Investment Required	Simple Payback Period	
	(MTOE)	(MTOE)	Effective	(MTOE)	(Million)$	Fin. (Yrs)	Eco. (Yrs)
Natural Gas	.214	.434	10%	.0214	8	1.8	1.1

Table F-7: Year Wise Phasing of Investment Required for Natural Gas Savings in the Steel Industry

										($ Million)
	Year 01	Year 02	Year 03	Year04	Year 05	Year 06	Year 07	Year 08	Year 09	Year 10
Annual	-	0	0	1	2	2	1	1	0	-
Cumulative	-	0	1	2	4	6	7	8	8	8

[29] Sustainable Energy Efficiency Development Program-Asian Development Bank (ADB) 2009

Investment Requirements

Based on the work of the Asian Development Bank, the energy efficiency improvement plan estimates the investments required to achieve the project savings.

These cost / investment estimates were developed based on the technical EE potential, and the extent to which this potential can be realized over a ten-year period taking into account the financial attractiveness of the investments and existing implementation barriers and constraints. Savings, both for the SSEE and DSEE in a ten year horizon will require an investment of US $ 8.5 Billion, much of which can come from the end user itself, if proper financing mechanisms are put in place and enabling environment established. Whereas the government is expected to fund about 20% the balance can come from the discos, international donors, CDM and NAMA programs, as well as through multinational banks

The investment costs for achieving these demand-side energy savings over the ten year were estimated by the ADB at $4.98 billion. Sectoral requirements are estimated at $2.4 billion for industry, $1.2 billion for the domestic sector, $ 0.47 for the Agriculture Sector and 0.685 for the transport sector. The overall demand-side savings potential in for the investments proposed are estimated at 7.14 MTOE (315,822 TJ), corresponding to about 11% of the total energy consumed in the country in that year.

The bulk of the investment will be required to replace existing inefficient equipment, followed by some additional investments to maintain efficiency in sectors where, due to market imperatives, the induction of lower efficiency equipment is expected to continue into the near future.

Planned energy savings in natural gas use are estimated at 8% of the total gas consumed in the country in FY 2012, and are projected at 2.1 MTOE (91,016 TJ) in the next ten years. The bulk of the savings potential in natural gas use is in the domestic sector (72% of total), and is associated with the replacement of existing appliances, such as cook stoves, water and space heaters, with high efficiency ones. Energy efficiency upgrades in industry account for 28% of the natural gas savings potential, which can be realized through modifications in production and manufacturing equipment, heat recovery, process improvements mainly in the cement, pulp and paper, and sugar industries, as well as loss reduction and efficiency improvements in the gas utilities' networks. Realizable savings for coal account for 9% of all coal consumed by industry, and can be achieved through implementing heat recovery in the cement industry.

The following table details the investment requirements for the DSEE as calculated by the reports / plans of the ADB and other donors:

Investment Requirement For 10 Years Demand Side Energy Efficiency (DSEE) Plan[30]

Sector	Energy Consumed, FY2008		Energy Savings, FY2019		Investment Required
	('000 TOE)	(TJ)	('000 TOE)	(TJ)	($ Million)
Domestic	8,046	355,659	2,074	91,696	1,288
Commercial	1,456	64,337	347	15,348	84
Industry	16,804	742,776	2,445	108,081	2,450
Agriculture	804	35,531	331	14,623	472
Transportation	11,567	511,297	1,906	84,224	685
Other Government	736	32,520	42	1,851	
Subtotal, Demand Side	**39,413**	**1,742,119**	**7,145**	**315,822**	**4,980**

[30] Sustainable Energy Efficiency Development Program-Asian Development Bank (ADB) 2009