

# **Energy Efficiency and Conservation**

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1 As of 17 July 08.



# Energy Efficiency and Conservation

Waqas Bin Najib

## Abstract

*The paper highlights the need for a comprehensive policy to promote energy efficiency. The importance of energy efficiency is underscored and attention is drawn towards the need for urgent actions to change behaviours and promote technological upgrades. Various policy options are discussed for the promotion of energy conservation and efficiency in different consumer sectors such as industrial, domestic and transport sectors.*

## 1. Introduction

Energy conservation and demand side management has not been a priority in Pakistan's energy policy. The current projections for energy demand growth are not sustainable even if Pakistan is able to exploit all its resources, which are not abundant. Most of the consumer market sectors are highly inefficient. Even with modest urbanization and economic growth, the demand growth is expected to be much higher in the future. If Pakistan is to develop a sustainable energy infrastructure to cater for economic growth and industrialization, she needs to develop strategies not only to produce more energy responsibly, but also to utilize what is available in an efficient manner.

The economic and social growth potential of the country is inherently connected to the manner in which the resources are consumed. Non-serious attitude towards energy conservation will have to be altered to avoid an unsustainable energy balance in the future. Energy conservation is the best way of managing and mitigating the adverse effects on the socio-economic sector. More importantly, energy conservation can also help to ensure a sustainable future for Pakistan. Promotion of energy conservation has to focus on both, a behavioral change towards power consumption and technological upgrades. Dearth of reliable information, absence of demonstration projects, lack of standardisation, and labelling of products are few of the major barriers to energy conservation.

The National Energy Conservation Center (ENERCON) announced the Energy Conservation Policy in 2005.<sup>2</sup> The policy identifies different potential areas for energy conservation and suggests guidelines. The policy, however, does not mention any firm targets, milestones, incentives, and measures for implementation of the suggestions. The policy is, therefore, viewed as irrelevant for the promotion of energy conservation in society.

ENERCON estimates the energy conservation potential to be around 25% on average for all sectors. This is in addition to roughly 25% transmission and distribution loss of the system in electricity supply. The conservation policy will have to focus on both, the primary energy and the electricity sectors. This will include improvements in the transmission and distribution system and changing the consumption patterns in commercial, industrial and domestic sectors.

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2 National Energy Conservation Policy 2005, National Energy Conservation Center, Ministry of Environment, Govt. of Pakistan, 2005.

According to the Ministry of Environment's status report<sup>3</sup>, the energy sector accounts for over 80% of the total CO<sub>2</sub> emissions in the country. Hence, this sector becomes the key focus of Pakistan's strategy in dealing with the issue of climate change. In the Asia Least-cost Greenhouse Gas Abatement Strategy (ALGAS) project, energy efficiency measures were identified as the key least-cost options in the short-term for GHG abatement strategy.<sup>4</sup>

Promotion of energy efficiency and conservation would result in financial benefits to consumers in the form of lower energy bills, in addition to positive externalities with respect to environmental issues. Conservation of energy is, therefore, paramount for climate change, environment, sustainable development and energy security.

## **2. Key Focus Areas for Energy Conservation**

A comprehensive energy policy to promote energy efficiency in the country must urgently be enacted. Within the energy sector, policy initiatives need to deal with a spectrum of areas. The policies must address the issues of efficiency in electricity production; improvement in transmission and distribution (T&D) and energy efficiency in the domestic, commercial, transport and industrial sectors.

### **2.1 Transmission and Distribution**

Gas and electricity transmission and distribution systems in Pakistan suffer from heavy losses. These contribute to a significant loss of resources and capacity of the infrastructure. In addition, losses add to the emission of greenhouse gases. Natural gas line losses emit methane to the atmosphere, whereas electricity losses result in additional supply from thermal power plants to meet the same demand. Natural gas line losses are currently at 7.5%<sup>5</sup>, compared to an international standard of 2–3% losses. Leakages in transmission and distribution are the major cause. Electricity T&D losses are estimated to be roughly 25%. Some estimates put the losses well above 30%<sup>6</sup> compared to a world average of 9%.<sup>7</sup>

No scientific studies have been undertaken to assess the losses in the energy transmission and distribution systems. However, the losses mainly come from out of date transmission networks, poor conditions of dispatch and distribution grids, and pilferage. Apart from electricity and gas theft, the rest can be improved by updating the infrastructure and improving the distribution networks.

An unavoidable loss of around 10% inherent to the electricity T&D system may be acceptable, but wastage of more than a quarter of electricity generated is a real cause of concern. This is of greater concern for the electricity generated from thermal power plants. Conversion of primary energy into electricity is an inefficient process in itself; a unit of electrical energy is obtained from 3 units of thermal energy. A loss of a quarter of electrical energy in T&D amounts to a total loss of three-fourths of the energy from the primary source. Thus, reducing these losses will have to be a top priority in energy conservation strategy for the country. With current levels of electricity production, just improving the transmission and distribution system can save at least 2000 MW of electricity.

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3 State of Environment Report, Pakistan Environmental Protection Agency, Ministry of Environment, Govt. of Pakistan, 2005.

4 Asia Least-cost Greenhouse Gas Abatement Strategy (ALGAS) – Pakistan, Asian Development Bank, 1998.

5 OGRA Annual Report 2006-2007, Oil & Gas Regulatory Authority, 2007.

6 M. Saleem, Technical Efficiency in Electricity Generation Sector of Pakistan – The Impact of Private and Public Ownership, Pakistan Society of Development Economics, 2005.

7 Energy Cooperation in South Asia: Potential and Prospects, RIS Policy Brief, No 8, 2003.



Unbundling of Water and Power Development Authority (WAPDA) has been a slow process. Pakistan Electric Power Company (PEPCO) now overlooks operations of electricity generation, transmission and distribution through the National Transmission and Despatch Company (NTDC), Distribution Companies (DISCOS) and Generation Companies (GENCOS). The poor status of T&D calls for a reform of NTDC and DISCOS. Asian Development Bank has started projects to enhance power transmission<sup>8</sup>, and capacity building of NTDC.<sup>9</sup> These projects are in the right direction. In addition, localization of power generation and upgrades of transmission networks is also required to help minimize the losses.

The natural gas operations are currently overseen by Sui Southern Gas Company (SSGC) and Sui Northern Gas Pipeline Ltd (SNGPL). Oil and Gas Regulatory Authority (OGRA) regulates the gas sector. Further devolution and distribution of natural gas by regional/local companies will improve the efficiency of these companies. Just like electricity distribution, gas distribution can also be commercialized.

Energy theft is a complex issue given the socio economic scenarios and lack of trust in government institutions. Commercialization of local distribution networks can help by better management, improved oversight, better control over metering faults and reduced billing irregularities. Better service can also be provided to the consumers by privately owned local distribution companies. Localization of distribution companies can become effective if the electricity/gas supply companies, under the Government's regulation, can be made profit oriented commercial entities.

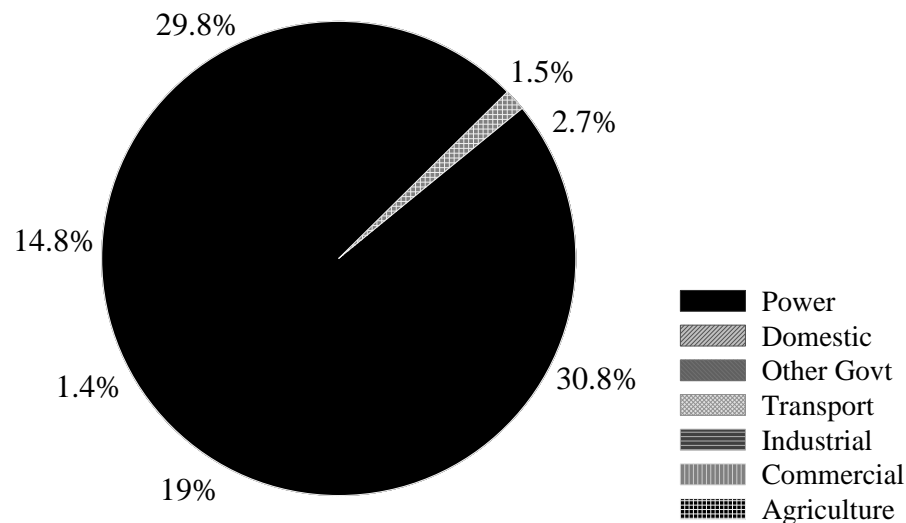
Hence, the following recommendations are proposed for reduction in T&D losses:

- Further decentralize WAPDA.
- Decentralize SSGC and SNGPL (operational unbundling).
- Undertake reform and capacity building of NTDC.
- Localize electricity and gas distribution networks on a commercial basis.
- Efficient government regulation of private local distribution companies to safeguard public interests.
- Develop firm targets for reduction in T&D losses and create an independent monitoring body for the evaluation of progress.
- Announce efficiency and performance based incentives/awards for companies.

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8 Pakistan: Power Transmission Enhancement Investment Program, Asian Development Bank (ADB) Annual Report, Loan 37192-PAK, 2008.

9 Institutional Capacity Building of the National Transmission and Dispatch Company Limited (NTDC), ADB, TA 4130-PAK, 2007.

Figure 1: Primary Commercial Energy Consumption by Sector (2007)<sup>10</sup>

## 2.2. Industrial

Almost a third of the total commercial energy supply is consumed by the industrial sector. The potential for energy conservation and energy efficiency measures in this sector is huge. It is estimated that at least a quarter of energy consumed in this sector can be saved by implementation of energy conservation practices.

The reluctance of industrial management to implement energy conservation measures is a barrier identified by various surveys. Despite the financial benefits possible from energy conservation there appears to be a lack of interest from the management. The situation points towards lack of awareness, over reliance on government subsidies, and difficulty in readjusting dispositions. The efficient end-use of energy, reduction in energy losses, process improvements, and better energy management, are required in the industrial sector. The government needs to undertake an approach to raise awareness about the technologies, best practices, and cost-benefit analysis of the energy efficiency programs in industry. Moreover, energy auditing must be promoted in all sized industries. Following actions can be considered in the short term:

- Establishment of credit lines for energy-efficiency measures.
- Investment funds or low-interest loans for investment in efficiency improvement.
- Facilitating market through financial incentives and rebates on import of cogeneration, waste heat recovery and other energy efficient systems.
- Transparent implementation of strict environmental standards.
- Promoting research in energy efficiency in the local universities.
- Raising awareness about productivity enhancement and cost-benefit analysis of energy efficiency measures.
- Creating an enabling environment for voluntary actions by promotion of corporate responsibility towards the society and environment.

10 Pakistan Energy Yearbook 2007, Hydrocarbon Development Institute of Pakistan, 2007.

### **2.3. Domestic and Commercial**

Roughly half of the electricity produced is consumed by the domestic sector. shows the electricity consumption by sector for the year 2007.<sup>11</sup> The major portion of this consumption comes from lighting, cooling, and entertainment. A significant saving can be made just by promoting energy conserving behaviors in consumption. Inefficient building designs also contribute heavily towards wastage of energy.

A survey of household commercial energy use, found out that consumers did not cut back their consumption of electricity and natural gas despite a rise in the prices faster than Consumer Prices Index (CPI) between 1994 and 2001.<sup>12</sup> Unless behavioral change is promoted in the society by concerted effort, energy conservation will be hard to achieve. Raising awareness in the public about energy efficiency and conservation should be a key focus in policy initiatives.

To reduce the domestic sector energy consumption, energy efficient building designs must be promoted. Education and awareness of building designers, town planning authorities, local bodies and public is necessary in this regard. Simple design measures can improve efficiency, like proper use of sunlight, building insulation, improved wall construction, properly selected windows, and designs according to the building use. An integrated building design code, especially for commercial and large-scale residential projects should be introduced. Proper implementation and enforcement of an updated building code can contribute highly towards reduced consumption in the future. Building codes on natural light and thermal insulation need to be legislated, and the legislation implemented.

One third of the natural gas is consumed by residential and commercial sectors. Majority of this consumption comes from use in cooking, water heating and space heating. Promotion of efficient stoves and space heaters is necessary. Highly inefficient devices are currently being used by the consumers, which are also hazardous to users and often result in fatal accidents. For water heating solar thermal water heating should be promoted as a priority on urgent basis. The technology is cost-effective and the local market has enough technical expertise to produce the equipment. Solar water heating should be integrated in the new building designs.

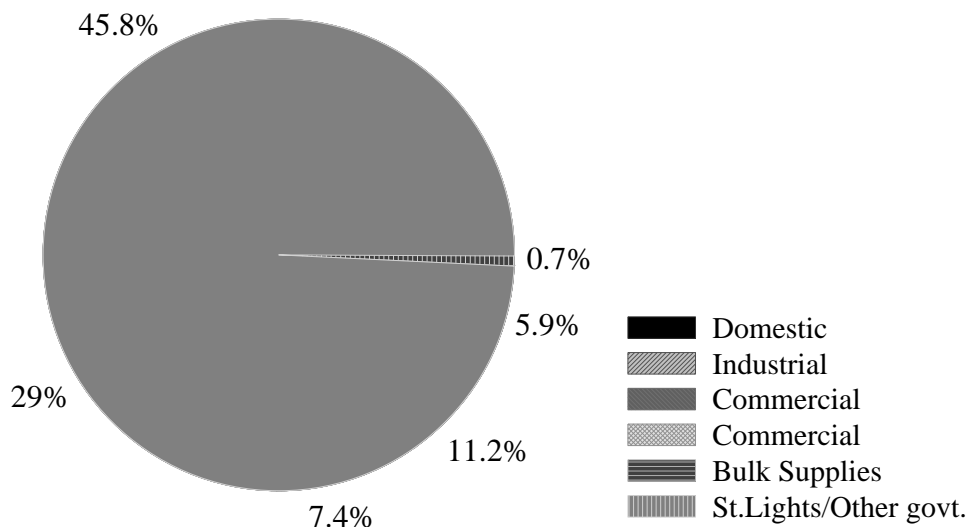
For a short-term reduction in domestic electricity consumption, Compact Fluorescent Lights (CFL or energy savers) should be promoted to replace inefficient incandescent lighting. The government's initiative to distribute CFL at whole-sale prices is a welcome measure. However, it is important to realize that no one action can bring in the required major change. There needs to be a broad ranged effort in changing behaviors, in addition to provision of cost-effective and affordable replacements of appliances.

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11 Ibid.

12 Masami Kojima, Pakistan: Household Use of Commercial Energy, Energy Sector Management Assistance Program (ESMAP), World Bank, 2006.

Figure 2: Electricity Consumption by Sector (2007)



Pakistan should employ a target oriented and aggressive strategy to improve electricity consumption in the domestic and commercial sector in a short time. There is an urgent need to introduce a standardized energy labelling system for domestic appliances. An independent body with technical expertise and know-how should be established to provide reliable and accurate energy ratings for the products. This can contribute towards changing the mindset of the consumers in selection of equipments. Additionally, minimum energy standards should be introduced for household appliances in the market.

Tariff restructuring (differential/time of use) can also help in reducing the consumption. Baselines for residential and commercial consumers can be defined on the basis of covered area, occupancy, type of activity etc. However, as a policy measure the low-end consumers should not be squeezed in the net, and the caps on consumption should be for high-end and commercial consumers only.

The Government's decision to introduce daylight saving time (DST) is another welcome measure. Both lighting and cooling requirements are reduced with DST. In 2002, Pakistan unsuccessfully experimented with the DST, and later abandoned the practice. Absence of an effective public awareness campaign was largely to blame for the unsuccessful attempt. The scenario is similar today; the DST was implemented without any awareness campaign. A large segment of population which schedules the activities of the day according to prayer times is neither bothered about the DST, nor understands it. There are also negative signals from the decision makers about the measure being for the short-term only. The practice should not be discontinued; rather efforts should be made to enhance its understanding in the public.

Strict commercial sector timings are observed in most energy efficient societies (Northern Europe, for example). Pakistan should also consider an 8 to 8 working window for the commercial sector. All markets, (with the exception of food business) should close at 8 p.m. and be allowed to open at 8 a.m. in the morning. The cafés/restaurants can be allowed to remain open till midnight. It will consequently give less time to people for shopping and recreation, which can be tackled by enforcing either an early start of work, or by fewer working days per week. Such an initiative will have strong resistance from many segments of the society. There is a need to build awareness about the measure and take all the stakeholders into confidence for effective implementation. Once agreed, the measure should be strictly implemented.

There are reports that the Government is mulling the idea of five working days a week.<sup>13</sup> It is expected that changing the weekdays would save more than 800 MW. This can be an effective measure to cut down on energy consumption. In addition to considerable energy savings, a five workday regime contributes towards improving quality of life. It provides people with more time to relax and attend to their personal issues during the off days. It is thought that a five working day routine also improves the working efficiency of most people and reduces absentees at the workplace. However, it translates to more working hours each day. This would mean that the changes in commercial sector timings and number of workdays will have to be brought conjointly, to protect the interests and well being of all stakeholders. Without a consensus on the measures from the commercial sector, employers, and the employees, the measures are unlikely to meet success and desired objectives. A word of caution: half hearted measures will be counterproductive. If partial measures fail today it will make it difficult to implement such moves in the future.

Characteristically, change is only expected from the lower echelons of society. Government officials and the elite go on with their business as usual. One rarely sees energy conservation and efficiency measures in government buildings. Exuberant consumption by high-end markets and commercial outlets is also commonplace. If change has to be brought about in the society, it should necessarily start from the top. Government buildings and big commercial outlets should set an example, not only by using energy-efficient lighting, but also by demonstrating overall energy-efficient behavior. To summarize, we propose the following policy measures in the domestic/commercial sectors:

- Enactment of integrated energy efficient building code.
- Promotion of energy efficient lighting/appliances.
- Vigorous promotion of solar water heating in residential and commercial sectors.
- Introduction of energy labelling and minimum standards for household appliances.
- Electricity tariff restructuring for high-end customers.
- Continuation of daylight saving time practice.
- Implementation of strict commercial sector timings.
- Introduction of five work days a week regime.
- Raising public awareness about energy efficiency and conservation.
- Ensuring energy efficient behavior by government departments and the affluent social class.

## **2.4. Transport**

The transport sector consumes 27% of total energy supply. Majority of this consumption is from the road transport sector. Of the total consumption in transport sector, almost 70% is consumption of high speed diesel, followed by 14% of natural gas and 12% of motor spirit. Aviation sector consumes roughly 6% of the total consumption in the transport sector. Alongside consumption, the urban private transport is also a major contributor towards poor air quality, noise pollution and excessive load on road networks.

Absence of a reliable and efficient public transport system in the urban areas is to blame for the situation. None of Pakistan's metropolitan cities has a mass transit system to address the requirement of mobility. Inevitably the population has to rely on private transport, resulting in higher energy consumption and environmental degradation.

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13 Strategic Policy Directives of Government of Pakistan on Energy Conservation, Prime Minister Secretariat, 24 January 2008.

There is an urgent need to launch plans for mass transit systems in major cities of Pakistan. Karachi and Lahore with populations well above 5 million have a dire requirement for efficient public transport system. Other cities like Faisalabad and Rawalpindi with populations above 1.5 million also need an effective public transport system. The mass transit system will not only reduce energy consumption, but also trigger economic development in the society.

For inter-city transport the railway system must also be urgently upgraded. Reforming the Ministry of Railways, to enable it for delivering an efficient and reliable service is the need of the hour. Localization of National Railway's operations by introducing provincial and local railway bodies can be an effective step which will bring economy of scale and scope. However, the Ministry of Railways can provide strategic, regulatory and policy guidelines to the local railway bodies to ensure social equity, affordability and balance in development. In most societies of the world, railways are part of the public sector, and are not meant to be profitable.

A campaign to raise awareness about improvement in energy efficiency of vehicles should also be launched. Better engine and vehicle maintenance should be promoted. The Government should also facilitate introduction of fuel-efficient engines and vehicles in the market. Vehicle fuel efficiency standards should be introduced and locally manufactured automobiles must meet minimum standards. However, the socio-economic scenario of a large population dictates reliance on old vehicles.

Given the poverty level and in the absence of efficient public transport systems, a large number of old vehicles (mainly taxis) continue to ply on roads. Stopping them may hurt the livelihoods of a number of people. Most of these vehicles run on very old engines that are inefficient consumers of gasoline, as well as cause more emissions. The Government should enact a policy to promote local engine manufacturing and reconditioning of these old vehicle engines. Only if the engine improvements for the older vehicles can be done at an affordable price, the vehicle efficiency standards will be implemented. Regardless, the standards should be introduced for the new vehicles coming in the market as a long term policy measure.

There is also a need to introduce bicycle culture in the urban settlements. Planned cities like Islamabad are best suited for this option. Cycle lanes should be included in the master plan of the city, and people should be encouraged to use them for private use. Briefly, the following recommendations are made:

- Introduction of mass transit systems in the major cities of Karachi and Lahore.
- Efficient public transport systems for large cities.
- Development of reliable inter-city railway service.
- Operational unbundling of Pakistan Railways to make more efficient localized entities.
- Improvement in engine and vehicle efficiency.
- Introduction of vehicle fuel efficiency standards.
- Promotion of bicycle culture in urban areas by construction of bicycle lane networks.

### **3. Conclusion**

There are energy crises in the offing beyond the one Pakistan is facing today. With only half of the population connected to the electricity grid, and even less to the gas network, Pakistan's energy problems are bound to grow in the future even with modest urbanization and growth. Oil dominated electricity supply mix is weighing upon the society with soaring oil prices. With very limited indigenous oil and gas resources, Pakistan must shift its energy policy focus towards energy efficiency and conservation along with exploitation of indigenous resources for power production.

Reduction of unnecessary consumption and conservation is the first step in managing demand. Energy efficiency has to be made the characteristic of the consumption market, which will not be possible with short-term cosmetic measures alone. Commitment, vision and political will are required by the leadership to bring about behavioral changes in the society.

The future electricity supply mix must have a lesser share of fossil fuel based power generation. Renewable energy ought to be a priority for future energy policy. Indigenisation of renewable energy technology will help in cost reduction of the equipment, along with growth in other socio-economic sectors. Small hydro, biomass, wind and solar are the technologies of choice in sustainable energy production. Utilization of local coal reserves using clean coal technologies will enable the country in meeting the medium-term demand in a sustainable manner. A strategic vision is required in dealing with the long term energy challenge, where both energy supply planning and demand side management are addressed.

Pakistan has to look through the current crisis and enact policies that can ensure energy security for the future. Development is hinged upon energy security, and the challenge is to build sustainable energy supply coupled with sustainable demand.