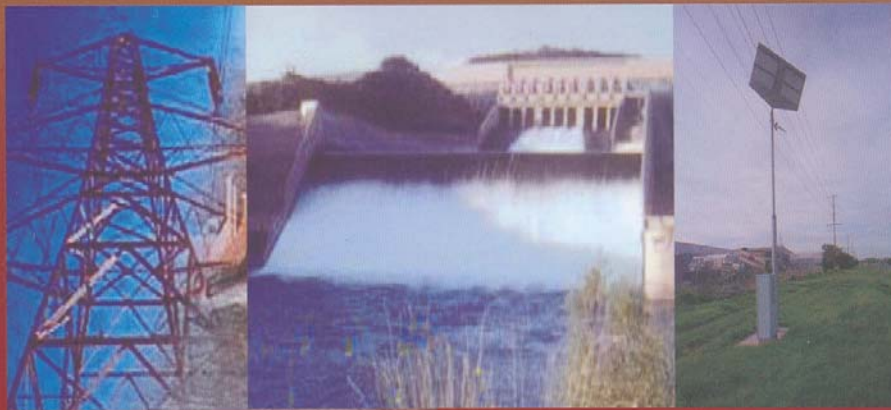




Readings in Economics 1

ENERGY ISSUES IN PAKISTAN



Edited by

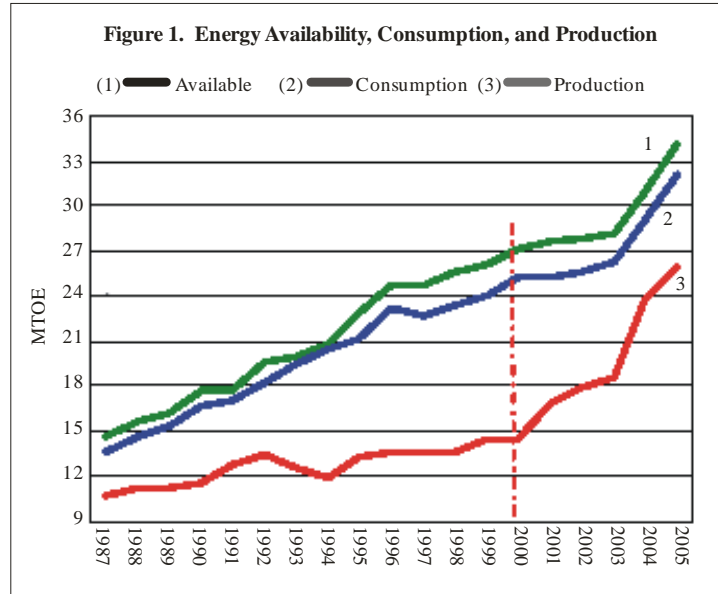
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INTRODUCTION

Pakistan is an energy-deficient country. According to a recent report, during the decade of the 1980s, the local production of energy satisfied only 86 percent of domestic demand while the remainder of the demand for energy was met by imports.¹ This demand-supply gap worsened by 2000, reaching a figure like 47 percent.² (See Figure 1)



Source: State Bank of Pakistan. *Second Quarterly Report for Fiscal Year 2006*.

Given this serious situation, the government undertook a variety of measures to increase the domestic supply of energy. As a consequence, the demand-supply gap for energy decreased to 18 percent by 2005. Much of this increase in supply was brought about by the increased availability of natural gas. The other major sources of energy used in fuel consumption are oil, electricity, and coal. The table below shows the energy distribution by fuel type (in percentage) for the 1980s, 1990s, and 2000s, for various sectors of the economy.

Table 1
Energy Distribution by Fuel Type (Percent)

	1980s				1990s				2000s			
	Oil	Gas	Elec	Coal	Oil	Gas	Elec	Coal	Oil	Gas	Elec	Coal
Household	35.5	25.5	38.4	0.5	39.3	39.1	21.6	0.0	5.8	62.4	31.8	0.0
Agriculture	29.9	0.0	70.1	0.0	38.8	0.0	61.2	0.0	32.9	0.0	67.1	0.0
Industry	12.9	53.6	19.9	13.6	30.5	54.0	6.2	9.3	28.8	56.2	5.4	0.0
Services	86.2	5.7	8.1	0.0	92.5	4.9	2.6	0.0	88.2	9.2	2.6	0.0
Transport	100.0	0.0	0.0	0.0	99.9	0.0	0.0	0.0	96.8	3.2	0.0	0.0
Commerce	3.0	40.2	56.9	0.0	7.8	61.0	31.2	0.0	0.0	71.3	28.7	0.0
Others/Govt.	66.1	0.0	33.3	0.6	65.2	0.0	34.8	0.0	51.9	0.0	48.1	0.0

Source: State Bank of Pakistan. *Second Quarterly Report for Fiscal Year 2006*.

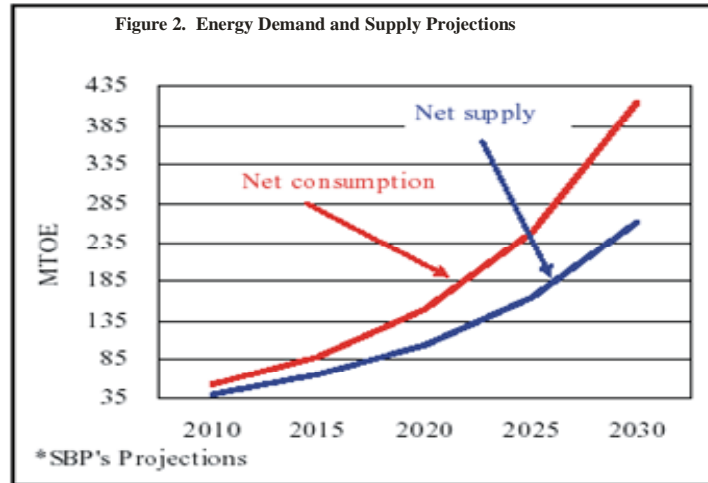
The use of energy by different consumer groups has also changed over time. In the 1980s the household sector derived 35.5 percent of its energy requirements from oil, 25.5 percent from gas, and 38.4 percent from electricity. By the 2000s, this sector was satisfying 62 percent of its energy needs from gas alone. The other two major sectors of the economy, the industrial and the services sectors, also increased

¹State Bank of Pakistan. *Second Quarterly Report for Fiscal Year 2006*.

²Ibid.

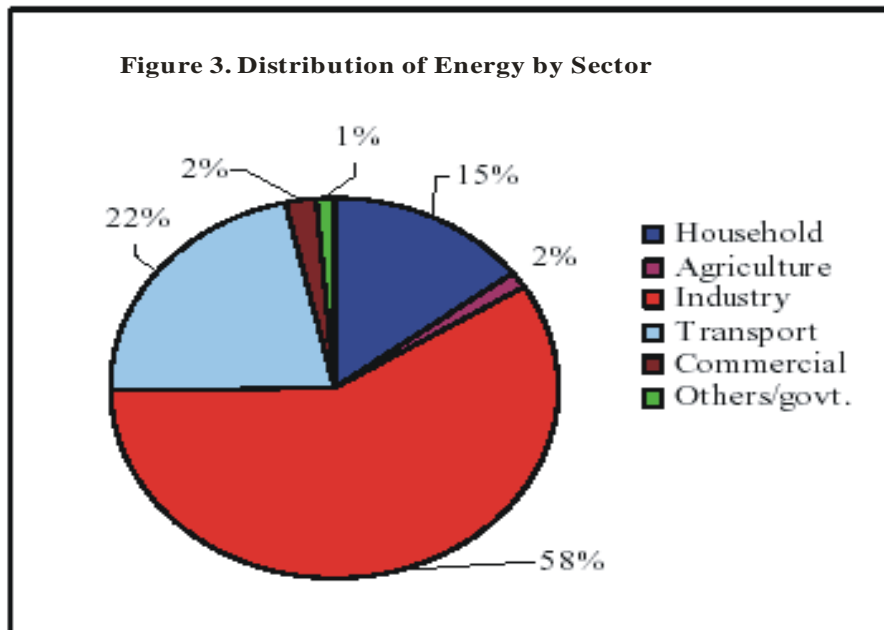
the use of gas as a form of energy.

However, if the existing growth pattern for the demand of energy is extrapolated then the energy consumption in the country is estimated at 150 million ton oil equivalent (MTOE), whereas the supply would be 103 MTOE³ (Figure 2). This gap of some 31 percent would be met by imports in the short term, and by additional investment in this sector by the government in the long term.



Source: State Bank of Pakistan. *Second Quarterly Report for Fiscal Year 2006.*

Figure 3 shows the sectoral distribution of energy. The largest sector is industry at 58 percent followed by transport at 22 percent, household at 15 percent, agriculture and commercial 2 percent each and other/govt. 1 percent. However it should be noted that the consumption mix of energy the industrial and services sector changed over time; electricity consumption decreased, gas consumption increased. In addition, both these sectors also raised their consumption of oil as well.



Source: State Bank of Pakistan. *Second Quarterly Report for Fiscal Year 2006.*

³Ibid.

As energy consumption in Pakistan in the last decade 1995-96 to 2004-05 has significantly increased due to higher levels of economic growth; 5.1 percent 2002-03, 6.4 percent in 2003-04 and 8.4 percent in 2004-05 to maintain this growth momentum the Pakistani economy would require cheap and abundant energy supplies in the coming years.

Currently, the energy sector in Pakistan is faced with the following issues:

- privatisation/efficiency
- demand for energy
- energy and economic growth
- rural electrification/ independent power producers
- need for an energy policy
- alternative and renewable energy.

Thus the papers presented in this edited volume may be divided into six segments or parts. In the first segment, three papers deal with the issue of privatization and performance of the electric power sector in the country. These papers entitled “Privatisation of Electric Power Sector in Pakistan: Some Important Issues” and “Performance of the Public Electric Power Industry: Evidence from Pakistan” are by Abdul Ghafoor and John Weiss. The third paper is by Nausheen H. Anwar. The first paper deals with the inefficiencies inherent in the electric power sector, by trying to identify them. Under pricing, subsidisation, overstaffing and poor maintenance are some of the root causes of the problem affecting the electric power sector of the country. However, to overcome these problems the authors suggest that pure privatisation is not the answer. In the short run, privatisation may bring in funds but, in the long-run, other problems, for example, inappropriate planning, energy dependency, and insecurity may arise. The authors also highlight the fact that the existing problems in the electric power sector of Pakistan are based on institutional and organizational constraints. The ideal solution they suggest is a combination of a public/private partnership which could lead to greater efficiencies in improving the performance of the electric power sector in the country.

The second paper also by Abdul Ghafoor and John Weiss examines the performance of the public electric power industry in Pakistan, both at the individual firm level as well as at the sectoral level. The paper highlights the issues whereas at the same time lists the appropriate physical, financial and productivity indicators that are used in appraising the performance of the public electric power sector. WAPDA and Keck’s performances are compared. The results are interesting. WAPDA had done better overall than the KESC (now privatised). However, if both their performances are compared with the net profit earned by similar entities in Turkey their performance is abysmal. In Turkey, the net profit indicator ranges between 20-36 percent. For WAPDA it is 12 percent and KESC, 9 percent. If one uses the indicator of total factor productivity growth this is negative with respect to the KESC and quite low in the case of WAPDA. What this suggests is that these enterprises need to be reformed, management improved etc. to achieve the best performance. One possible approach could be to separate the generation, transmission and distribution facilities within the power sector which should result in greater competition between the various players with increased efficiency leading to greater output in the long run.

The third paper by Nausheen H. Anwar is based on the results of a micro-level study of manufacturing firms in Karachi. Given the frequent power breakdowns in Karachi, which is the largest financial and commercial centre of the country, a large number of firms in the manufacturing sector have set up their own individual power generating units. This situation was largely brought about by the failure of the public sector to provide electricity cheaply and efficiently to the manufacturing sector in Karachi. The author identifies the following types of failures.

Transmission and distribution losses and non-technological reasons which are institutional in nature are given as the major causes of inefficiency in electricity supply by the KESC. Four options are identified by the author that deals with how firms respond to the inefficiencies created by the KESC. The most obvious one is for the firm to have its own generating system, not relying on any external source. The second option is to use private generation only when the public supply falls short or becomes erratic in cases of emergency. The third option is for the firm to have private generating capacity but taps into

the public source when it is deemed to be reliable. The fourth option is for the firm to rely solely on the public source for the provision of power no matter how unreliable.

Another feature that has emerged in Karachi is that where the public supply of power has become unreliable, local firms have taken on the task of supplying electricity, outside the ambit of the public sector. This provision of power, although reliable, is costly. The policy implications of the study are of interest. Raising tariffs may improve locative efficiency but this may cause a greater burden to be borne by industry. A more feasible solution would be to encourage the private producers to supply power directly to those who wish to consume it. Also, it would be a good idea to open up the field to greater competition: WAPDA and KESC should not be the only two entities providing electric power—other firms should enter the market for the supply of power. Consumers can then choose among a number of supplying firms from those that are most efficient.

The second part of the volume deals with demand which has risen rapidly over the past decade—1996-97 to 2005-06. If one looks at the figures of electricity consumption by economic groups, the domestic sector is the largest consumer (43.5 percent) in 2004-05 followed by the industrial sector (28.1 percent), agriculture (12.5 percent), bulk supply and public lighting (10.1 percent) and commercial (5.8 percent). All percentages are for 2004-05.⁴

The next three articles by Mahmood Iqbal, Nadeem Burney and Naeem Akhtar, and Salim Chishti and Fakhre Mahmood deal with the demand for energy. The first article “Residential Demand for Electricity and Natural Gas in Pakistan” by Mahmood Iqbal estimates income and price elasticities of electricity and natural gas using the OLS and GLS methods. The research shows that both income and price elasticity are statistically significant. Certain policy implications can be drawn from the study. In particular, the following issues need to be addressed from a policy viewpoint: (a) how high should the price of a specific fuel be increased so that the demand for that fuel is contained/curtailed? (b) As the income of the consumer rises, how much of this additional income would be spent on fuel? (c) Furthermore, does the consumer distinguish between various types of fuels as substitutes or complements? A clear-cut answer would help in formulating policies with respect to the demand for electricity and natural gas. The article also suggests directions for future research in the area.

The second article “Fuel Demand Elasticities in Pakistan: An Analysis of Households’ Expenditure on Fuels Using Micro Data’ by Nadeem A. Burney and Naeem Akhtar analyses these fuel demand elasticities using household level data provided in the Household Income and Expenditure Survey. The methodology applied is that of the Extended Linear Expenditure System. The study reveals some interesting outcomes. The first is that rural households have different expenditure patterns as compared with urban households with rural households spending relatively more on energy. Secondly, it is made obvious from the study that both urban and rural households consider that all fuels are necessities. Thirdly, as incomes change the expenditure on fuel is relatively unchanged. Fourth, the use of firewood in urban areas as a source of fuel is low. Fifth, the marginal propensity to consume fuels is low in the country. A more important finding of the study is that if you raise fuel prices by 100 percent expenditure by urban households will increase by only 3 percent whereas that of rural households by 2.3 percent. Similarly, if fuel prices are increased by 100 percent assuming household income levels are given, then the savings of urban households will decrease by 24 percent and those of rural households by 17 percent.

The third article on this segment looks at the demand for energy in the industrial sector of Pakistan and is by Salim Chishti and Fakhre Mahmood. The methodology followed is that of a Translog production function with substitution possibilities between energy and non-energy inputs. The impact of pricing policies on demand has also been taken into consideration. The findings of the study shows that energy can be considered to be a separate factor of production. The paper estimates various price elasticities. The Allen-Uzawa partial substitution elasticities have also been estimated. The results further show that own-price elasticities reflect an inelastic demand for inputs. However, cross-price elasticities reveal that energy and labour and capital and labour are substitutes. Higher prices of energy will have a negative impact on investment in capital goods whereas on the other hand, high energy prices will favour more labour

⁴Government of Pakistan. *Economic Survey 2005-2006*. Economic Advisor’s Wing. Ministry of Finance.

absorption, hence employment. Thus, appropriate demand management policies can be introduced that take into consideration these elasticities of substitution.

The third part of this edited book consists of two papers dealing with the relationship between energy and economic growth by T. Riaz and the second by Rehana Siddiqui.

The link between energy and economic growth is well established. Energy has played a central role in providing food as well as the accoutrements that go with comfortable living. If one traces the history of energy use it was in the Neolithic period that the demand for energy substantially increased when nomadic lifestyles changed to that of settled communities with the beginnings of development in agriculture and related activities. Other developments through time included mechanical devices based on wind and water power. With the advent of the metal age the smelting of copper and iron required greater amounts of energy which resulted in the destruction of vast areas of forests that were cut down to provide the charcoal necessary as the fuel component. Further, with the onset of the Industrial Revolution in Europe in the Seventeenth Century the demand for energy increased, the new machines using innovative types of power promoted economic growth.

The first paper in this segment is by T. Riaz stresses the link between energy consumption and economic growth. Three aspects are highlighted in the paper. The first is an attempt to estimate the future demand for energy in Pakistan keeping in view past practice. The second aspect is the development of an energy sector plan with links to the rest of the economy. And third, the author develops a two-way linkage approach between the energy sector and the non-energy sector. The analysis is limited by the availability of data and the methodologies involved which may not be consistent with each other. In depth research based on reliable data is needed if robust policy implications are to be drawn is the conclusion arrived at by the author.

The second paper by Rehana Siddiqui discusses in detail the relationship between energy and economic growth as applied to this country. The relationship has become all the more important because of the finite nature as well as the rising prices of all the fossil fuels e.g. oil, coal, and gas on which much of modern economic growth has been dependent. It is not surprising then that a causality exists between energy use and economic growth. However, the study points out that different sources of energy influence economic growth in different ways. An increased use of energy, either through natural gas or electricity, impacts favourably on the living standards of the poor as they then spend less time looking for alternative forms of fuel such as firewood. Similarly, the provision of electricity to the rural areas can help in raising productivity levels of small-scale industry thereby indirectly raising income levels and in the longer term improving the quality of life for the rural poor. The author estimates two growth models: an output growth model and a productivity growth model. The results of the analysis reveal that energy plays a very important role in determining economic growth. To ensure continued economic growth, the author stresses the need to develop alternative sources of energy which are available on an uninterrupted basis. Reducing reliance on fossil fuels would also result in easing pressure on the balance of payments. Future growth thus depends on affordable energy. The issue of good governance as well as accessibility of energy supplies to all should also be followed as a matter of policy. Privatisation and deregulation may not be the answer as it may result in higher prices and job losses. A final point raised in the paper is that of substituting one type of fuel for another as prices change. This issue needs to be researched further.

The next two papers look at the economics of rural electrification, and the issues behind the independent power producers. Rural electrification is important because it brings to the rural areas the benefits that urban consumers take for granted—an improvement in the standard of living with the associated socio-economic benefits. Provision of electric power also has a purely economic outcome that of increasing the productive capacity of the rural areas with increases in agricultural output. In Pakistan, by 2006 almost a 100,000 village are being provided electricity.⁵ In 1995-96, the number of villages electrified was only 62,127.⁶

The first paper in this segment “The Economics of Rural Electrification Projects: Theory and Case

⁵Ibid.

⁶Ibid.

Study of Pakistan” by Mark W. Gellerson appraises rural electrification projects in the country within the framework of cost-benefit analysis. An economic benefit has been identified when consumers switch from using costly kerosene to cheaper electricity. Similarly, for irrigation tubewells users switch from diesel pumps to electric pumps. The savings that result are termed economic benefits.

Costs that are included in the analysis are investment and operating costs. The results of the cost-benefit analysis are interesting. Rural electrification in the Punjab and Sindh provinces have the highest economic internal rates of returns. NWFP and Balochistan have the lowest. However, if political and social considerations are taken into account rural electrification in these two provinces becomes justifiable.

From the early 80s the demand for power was greater than its supply. At peak periods it thus became necessary to introduce load management or commonly known as loadshedding. Furthermore, demand continued to increase in the 90s at an average rate of 9 percent per year. Given this situation, it became apparent that the supply of power from the existing sources would be insufficient. In this connection the Government of Pakistan undertook a study in 1994 to estimate future power requirements by the year 2020. The study revealed that 9800MW of additional generating capacity was required by 2020. The power policy that resulted from this study allowed for the first time Independent Power Producers (IPPs) to enter the power sector in the country. To encourage investment, the private sector was enticed with a generous tariff policy among other incentives. As a consequence of this policy some 19 IPP projects were established and some \$3 billion in investment was made adding 3500MW to the existing capacity.

The second paper titled “IPPs: The Real Issues” by Anjum Siddiqui examines whether these independent power producers produce electricity that is more expensive than that produced by WAPDA, the public-owned entity. The paper provides the background against which IPPs were allowed to be set up, the project risks that were involved, the components of the electricity tariff and the reasons for their increase over time. The paper also discusses the differences in the cost of production of electricity by the IPPs and WAPDA. The author concludes that on the available evidence, the IPPs produce cheaper electricity than WAPDA, the state-owned entity.

Energy sector plans and energy policy form the fifth segment of this edited volume. Here, the two papers that are included are by T. Riaz and Peter Pintz. The paper entitled “A Long-range Energy Sector Plan for Pakistan by T. Riaz presents a linear programming model dealing with long range energy sector planning in the country.

It is a well-known fact that the energy sector in the country is composed of a number of interlocking relationships between the private and public sectors. Thus, the linear programming model that is developed in the paper is an all-encompassing one that includes the entire energy sector, and its objective is to simulate the demand and cost of energy in the future based on different assumptions. From these simulations one can draw the necessary policy implications with respect to supply and demand and pricing.

The second paper is by Peter Pintz and deals with demand-side energy policy. This became necessary because of the two oil price shocks, one in 1973 and the second several years later. This increase in energy prices forced the developed countries in particular to develop alternative energy policies that would maintain high growth rates but with little or negligible growth rates in energy consumption. The new energy policy that was formulated in the developed countries basically addressed the issue of demand rather than that of supply. Conservation of energy became important. In developing countries the supply of energy plays the more dominant role in energy policy compared with the demand side. This paper looks at the possibility of focusing on the demand side to control for the use in energy prices in Pakistan—an issue that is as relevant today as it was when this paper was written 20 years ago. Energy can be conserved substantially the author states going on the basis of the available data. However, for a comprehensive study detailed information would be required which at the moment does not exist in the country. However, data for other countries reveal that substantial savings can be achieved if demand-side energy policies are followed. In this connection, the author suggests a number of steps that would help promote energy conservation in the developing countries – the most important being to educate the people in matters relating to the conservation of energy. Other measures that need to be introduced relate to the appropriate financial and other incentives involved in encouraging people to limit their demand for energy.

The development strategy of a country would also need to be re-shaped, highlighting the importance of the use of indigenous energy technologies that are both appropriate and low cost. Furthermore, improve the infrastructure for public transport so that its cheapness and free availability will both be environmentally friendly as well as reducing the cost of imported energy in the form of the ever-rising price of oil. In Pakistan, this is now becoming a serious problem, where public transport is non-existent and private transport is ever expanding. The result is an ever-increasing oil bill, putting pressure on the balance of payments.

As oil imports are becoming costlier and proving to be a burden on the balance of payments, it is becoming essential to develop alternative forms of energy, in particular energy from renewable resources which can be commercially exploited. The importance of this was realised as far back as the early 1980s. The Sixth Pakistan Energy Plan (1983-88) allocated some 14 million euros for renewable energy projects. Earlier in 1975, the Pakistan Council of Appropriate Technology (PCAT) was set up. This was followed by the establishment of the National Institute of Silicon Technology (NIST) in 1981. The former institute's responsibilities lay in the areas of establishing small hydropower units, bio-gas plants, solar cookers and localised wind energy units. The latter organisation was more concerned with research and development as well as the commercial application of solar energy. The achievements of these two institutions in developing renewable energy was quite limited—amounting to less than 5MW by the end of the 1980s. The Pakistan National Conservation Strategy was announced in 1992 which saw the establishment of some bio-gas, wind power and small hydropower units for producing energy.⁷⁽⁷⁾

In Pakistan renewable sources of energy include; wind energy, solar energy, energy from micro-hydel units, and bio-energy. The potential to exploit these forms of energy is vast but given the lack of knowledge it is difficult to sell such forms of energy to the people who are more comfortable in using gas to meet their energy requirements. However to promote the use of renewable energy the Government of Pakistan has set up the Alternative Energy Development Board on 30th April 2005 by a Presidential Ordinance. This institution has outlined various short, medium and long-term plans to harness wind, solar and solar thermal sources of energy. The objective of the Government is that by the year 2015 renewable energy should make up 10 percent of the total energy mix in the country. Another problem is the relatively high cost of investment in renewable energy projects which needs to be addressed as the use of renewable energy helps support the idea of sustainable development creating a balance between the utilisation of a resource and its exploitation. Thus the last part of this edited volume consists of two papers. The first is by M. M. Qurashi entitled “Renewable Sources of Energy in Pakistan” and the second by Waqasullah Khan Shirwani, Fahd Ali and A. H. Nayyar titled “Electric Power Generation from Solar Photovoltaic Technology: Is it Marketable in Pakistan”.

The paper by M. M. Qurashi looks at the possibilities of developing energy from renewable sources. The author traces the history of energy use in the country noting the fact that as natural gas has become more easily available, consumers have shifted away from coal which formed the primary source of energy supply prior to natural gas. However, the supply of natural gas is not infinite. The recoverable reserves are estimated at 33 trillion cubic feet.⁸ and may not last beyond another couple of decades at current rates of consumption. If more gas fields are to be discovered and brought on line then massive investment would be required along with the necessary financial incentives. Similarly, the cost of oil has been going up regularly in the past few years reflecting increased international demand as well as the draw down on existing oil fields—the depletion factor. So given the rising cost of energy, it has become necessary to tap non-conventional and renewable forms of energy as their costing becomes more favourable. M. M. Qurashi, in his paper, identifies a number of sources of renewable energy that will add to the overall energy mix in the country. These sources include; hydropower, biomass, solar energy and wind energy. Solar energy can be divided into a number of sub-types; solar cells for the generation of electricity, solar collectors that directly trap the power of the sun and can be used for heating water, room

⁷“Power Sector Situation in Pakistan”, Report prepared by “Alternative Energy Development Board (AEDB) in collaboration with Deutsche Gesellschaft für Technische Zusammen Arbeit (GTZ) GmbH. Islamabad. September 2005.

⁸Government of Pakistan. *Economic Survey 2005-06*. Economic Advisor's Wing, Ministry of Finance, Islamabad.

cooling/heating and for purifying water. Such technology would be of great use in areas where it would prove too costly to connect to the national grid. Solar power could also be used for dehydration purposes—in particular, vegetables and fruit, which can then be preserved and marketed earning incomes for the farmers. Other applications of solar power include the pumping of water, and the cooking of food. Other lesser sources of renewable energy in the country include geothermal sources, tidal power and ocean thermal energy conversion. For further information on these lesser sources of energy supply, the writer says that the necessary data has to be collected before any decisions are taken.

The second paper examines the marketability of solar photovoltaic technology in Pakistan. The authors of this paper concede that this form of energy is expensive relative to existing forms of energy as far as establishment costs are concerned. Furthermore, solar technology is dependent on sunshine which may not be available on a constant basis. Despite these shortcomings, the authors have compared the costs of providing energy from a conventional source, a thermal power plant with that from a solar-powered plant. Basically the authors undertake a cost-effectiveness analysis of the two options. The major variables used in comparing costs include the discount rate, the rate of inflation, the real rate of increase in the prices of capital goods, the real rate of increase in the operations and maintenance costs and the real rate in the prices of input energy. The major assumption in these sort of analyses is that both options give the same level of benefit, in this case equivalent outputs of energy. The conclusion that emerges from their research is that at the given discount rate the thermal power plant is cheaper. This is no surprise. However, in a sensitivity analysis carried out later in the paper it is possible for the solar-powered option to be cheaper. The variable that is quite significant in this case is that of the discount rate, if this is lowered then the solar-powered option becomes feasible. The other two important issues that affect costs include installation costs and accelerated depreciation. The installation costs the authors say can be reduced by promoting the use of solar collector technology. Furthermore, it is important to develop and use indigenous technology as much as possible. This can be achieved by providing the appropriate fiscal incentives and giving tariff concessions for the import of solar-based technology. It has now become necessary, as the authors say, that this technology should move from small-scale utilisation to that of grid level if the cost of imported fossil fuels in particular, oil, keeps on rising on the international market.

If Pakistan is expected to grow on its anticipated growth path of 8.5 per annum, the energy requirements for such growth to be maintained is tremendous. It is expected that the country's total energy requirement could increase by 48 percent in the coming few years.⁹ The shortage of power production is expected to be some 5250 MW by 2010.¹⁰ Furthermore, the demand for oil as an energy source would also increase over the same period by 23 percent—a consumption of 21 million tons in 2010 as compared with 16.8 million tons currently.¹¹

To meet the challenge in the energy field, Pakistan has prepared a detailed 25 years Energy Security Plan totalling an investment outlay of \$150 billion for the period 2005 to 2030. This plan assumes even greater importance because at current rates of consumption natural gas and oil provide 80 percent of the country's energy requirements. However, domestic production of oil meets only 18.3 percent of the country's energy needs, the rest being imported which places a burden on the balance of payments. Furthermore, natural gas reserves are also beginning to deplete at a time when it is expected that the total demand for energy is anticipated to rise by 350 percent in the next two decades. It is expected that in this period domestic resources will contribute only 38 percent of the total energy required.¹² Thus, the challenges ahead are daunting and every avenue needs to be explored for the provision of cheap energy to sustain the high growth rates needed for poverty alleviation and other objectives of the government.

Finally, the papers presented in this edited book can serve as a springboard for further research in the energy sector of the country.

⁹Dawn, July 29, 2006.

¹⁰Ibid.

¹¹Ibid.

¹²Dawn, September 5, 2006.