*COMSATS-COMSTECH*

*National Seminar on*

# Policies and Strategies for Successful Implementation of Employment-Generating Programmes in Renewable Energies, Biotechnology, Agriculture, Environment and ICTs

*11th - 12th August 2009*

# PROCEEDINGS


*Edited by*

M.M. Qurashi, Tajammul Hussain, Irfan Hayee, Farhana Saleem



Commission on Science and Technology for Sustainable Development in the South (COMSATS)

**15**

**COMSATS' Series of Publications on Science and Technology**

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Commission on Science and Technology for Sustainable Development in the South

*Proceedings of COMSATS-COMSTECH*
*National Seminar on*

# Policies and Strategies for Successful Implementation of Employment-Generating Programmes in Renewable Energies, Biotechnology, Agriculture, Environment and ICTs

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# FOREWORD

The Commission on Science and Technology for Sustainable Development in the South (COMSATS) in collaboration with the OIC Standing Committee on Scientific and Technological Cooperation (COMSTECH) and the Higher Education Commission of Pakistan (HEC) organized a two-day National Seminar on 'Policies and Strategies for Successful Implementation of Employment Generating Programmes in Renewable Energies, Biotechnology, Agriculture, Environment and ICTs'. The seminar was held at COMSTECH Secretariat, Islamabad, on 11th and 12th August 2009.

The seminar was inaugurated on 11th August 2009 by Dr. Ishfaq Ahmad, a leading Pakistani scientist and the then Advisor on Science and Technology, Planning Commission of Pakistan, during a formal ceremony in Islamabad, Pakistan. Prof. Dr. Atta-ur-Rahman, Coordinator General COMSTECH, and Dr. I.E. Qureshi, Executive Director COMSATS, as well as other distinguished members of the scientific community were also present on the occasion.

The broad objectives of the seminar included: review existing national policies and strategies for employment generating programmes in targeted areas of the economy; share and exchange experiences and case-studies on best practices and promote a common understanding among participants on relevant issues; exploit the large potential in the developing countries to create productive jobs in all areas of economy and for all levels of skills and education, both for men and women; establish an explicit linkage between policy formulation and the generation of employment; integrate employment as a central point of concern of socio-economic policies, including the national development plans; identify practicable policies and strategies in the developing countries' prevailing socio-economic circumstances for promoting employment generating programmes related to renewable energy, biotechnology, environment, IT and agriculture; and identify specific recommendations that can ensure formulation of employment generating programmes. The proceedings of the two-day seminar comprised: comprehensive presentations on the suitable and economically viable technologies in the selected scientific fields, having potential for future economic growth and employment generation in Pakistan; a critical review of the existing policies, strategies and programmes relating to employment generation; and case-studies of successful strategies in Pakistan that have resulted in job-creation for the masses.

The two-day seminar was divided into six technical sessions, each focusing on a specific scientific area, in addition to a common theme of 'Promotion of Employment Generation'. Each technical session was followed by a panel discussion. Twenty-seven resource persons, predominantly scientists, industrialists, government representatives, policy-makers and scholars from renowned scientific institutions and/or organizations of Pakistan participated in the meeting. These resource persons

actively participated in the event and deliberated upon the best practices, policies and strategies to maximize the employment opportunities in the country, on a sustainable basis. The seminar also served as a platform for establishment of contacts amongst the participating subject-experts, scientists, technologists, scholars, policy-makers, entrepreneurs and young students for future interaction and for the follow-up actions based on the recommendations of the seminar.

The papers included in this publication have been reviewed by their authors, after editing and composing. Any responsibility about the correctness and authenticity of the data and information provided in this publication lies with the authors and not the publisher or editors.

**Tajammul Hussain**
Advisor (Programmes)
COMSATS Headquarters

# TECHNICAL PROGRAMME

# TECHNICAL PROGRAMME

## DAY ONE: Tuesday, 11th August 2009

### INAUGURAL CEREMONY

| | |
|---|---|
| 0950 hrs | **Guests to be Seated** |
| 0955 hrs | **Arrival of the Chief Guest** |
| 1000 hrs | **Recitation from the Holy Quran** |
| 1010 hrs | **Welcome Address**<br>Prof. Dr. Atta-ur-Rahman<br>*Coordinator General COMSTECH* |
| 1020 hrs | **Introductory Remarks**<br>Dr. Imtinan Elahi Qureshi<br>*Executive Director COMSATS* |
| 1030 hrs | **Inaugural Address by the Chief Guest**<br>Dr. Ishfaq Ahmad<br>*Advisor on Science and Technology*<br>*Planning Commission of Pakistan* |
| 1045 hrs | **Refreshments** |

### 1130 – 1300 hrs TECHNICAL SESSION - 1

**Theme**: Environment

**Chairperson: Dr. Iftikhar Ahmad Raja**
Rapporteur: Dr. Muhammad Khurshid

| | |
|---|---|
| 1130 hrs | 1. Renewable Energy and Employment Opportunities in Pakistan<br>*Dr. Iftikhar Ahmad Raja, Professor and Chairman,*<br>*Department of Environmental Sciences, COMSATS*<br>*Institute of Information Technology (CIIT), Abbottabad* |
| 1145 hrs | 2. Employment Generation and National Environment Policy of Pakistan<br>*Dr. Khalid Farooq Akbar, Associate Professor, Botany Department,*<br>*Govt. Post-Graduate College, Sahiwal* |

| | |
|---|---|
| 1200 hrs | 3. Role of Community-Based Sustainable Projects in Creating Green Jobs and Environmental Protection<br>*Ms. Iffat Ashraf, M.Phil. Scholar, Department of Environmental Sciences, GC University, Faisalabad* |
| 1215 hrs | 4. Capacity-Building and Employment-Generation in the Field of Satellite Remote-Sensing<br>*Dr. Mohsin Jamil Butt, Chairman & Associate Professor, Department of Meteorology, COMSATS Institute of Information Technology (CIIT), Islamabad* |
| 1230 hrs | 5. Sustainable Development and Income-Generation Opportunities in Pakistan<br>*Dr. Mohammad Khurshid, Deputy Secretary, Economic Affairs Division, Government of Pakistan, Islamabad* |
| 1245 hrs | Question & Answer Session |
| **1300 hrs** | **Lunch** |
| **1400 – 1520 hrs** | **TECHNICAL SESSION - 2**<br>**Theme**: Renewable Energies<br><br>**Chairperson: Dr. Ahmed Sohail**<br>Rapporteur: Dr. Syed Tahir Hijazi |
| 1400 hrs | 1. Energy Conservation Techniques in Industrial Setup of Pakistan with Integration of Renewable Energy Technologies in Context of Employment-Generation<br>*Dr. Ahmed Sohail, Asstt. Professor, Director, National Solar Lab., College of E&ME, NUST, Islamabad* |
| 1415 hrs | 2. Household Wind-Electricity Generating Units for Employment Generation<br>*Dr. Syed Tahir Hijazi, Professor, Faculty of Management Sciences, COMSATS Institute of Information Technology, Islamabad* |
| 1430 hrs | 3. AEDB Jobs-Creation Experience in Solar Home Systems (SHS) in Rural Balochistan<br>*Mr. M. Khalil Khetran, Director, Alternative Energy Development Board (AEDB), Quetta* |
| 1445 hrs | Question & Answer Session |

| | |
|---|---|
| 1500 hrs | Tea Break |
| **1520 – 1635 hrs** | **TECHNICAL SESSION - 3** |
| | **Theme**: Renewable Energies<br><br>**Chairperson: Mr. Irfan Yousuf**<br>Rapporteur: Mr. Muhammad Arshad |
| 1520 hrs | 1. Employment Opportunities in Renewable Energy Sector of Pakistan<br>*Mr. Irfan Yousuf, Deputy Director (CDM & Environment), Alternative Energy Development Board (AEDB), Islamabad* |
| 1535 hrs | 2. Solar-Thermal Energy Utilization: The Most Cost-Effective and the Best Employment Generating Energy Solution for Third-World Countries<br>*Prof. Waqar Haider Bokhari, Head R&D Lab., COMSATS Institute of Information Technology (CIIT), Islamabad.* |
| 1550 hrs | 3. Employment Generation through Bio-Ethanol Production Industry as Renewable Energy Source<br>*Mr. Muhammad Arshad, PhD Scholar, Deptt of Chemistry & Biochemistry, University of Agriculture Faisalabad* |
| 1605 hrs | 4. Wind-Energy Applications and Social Uplift of Local Population<br>*AVM (R) S. J. Raza, Chief Executive, Dawood Power (Pvt) Ltd, Karachi* |
| 1620 hrs | Question & Answer Session |
| | **DAY TWO: 12th August 2009** |
| **1000 – 1205 hrs** | **TECHNICAL SESSION - 4** |
| | **Theme**: Biotechnology and Agriculture<br><br>**Chairperson: Dr. Zafar Altaf**<br>Rapporteur: Dr. Zabta Khan Shinwari |
| 1000 hrs | 1. Generating Employment in the Excluded Areas |

| | |
|---|---|
| | of Pakistan<br>*Dr. Zafar Altaf, Chairman, Pakistan Agriculture Research Council (PARC), Islamabad* |
| 1015 hrs | 2. Wealth Generation Through Research: A Case Study<br>*Dr. Zabta Khan Shinwari, Professor, Department of Plant Sciences, Quaid-i-Azam University, Islamabad* |
| 1030 hrs | 3. Food Industry: Employment through Technology<br>*Engr. Abdul Mannan Usmani, General Manager, Shan Foods, Karachi* |
| 1045 hrs | 4. Coal Biotechnology: A Step Towards Sustainable Energy Development and Employment Generation<br>*Dr. M. Afzal Ghauri, Head Industrial Biotechnology Division, NIBGE, Faisalabad* |
| 1100 hrs | 5. Scope of Health-Biotechnology in Pakistan, with Reference to Employment Opportunities<br>*Dr. Tariq Majid, Manager, Business Development Cirin Pharmaceuticals (Private) Limited, Rawalpindi* |
| 1115 hrs | 6. Importance of "Biotechnology and How it can Help in Generating Employment-Opportunities and Contribute in Improvement of National Healthcare Standards in Pakistan"<br>*Dr. Khalid J. Chowdhry, Chairman & Chief Executive, MediPak Group of Companies, Kot Lakhpat, Lahore* |
| 1130 hrs | Question & Answer Session |
| 1145 hrs | Tea Break |
| **1205 – 1305 hrs** | **TECHNICAL SESSION - 5** |
| | **Theme**: Promotion of Employment Generation<br><br>**Chairperson: Dr. Musarrat Jabeen**<br>Rapporteur: Mr. Ali Kamal |
| 1205 hrs | 1. Innovative Entrepreneurship<br>*Dr. Musarrat Jabeen, Research Fellow, COMSATS Headquarters, Shahrah-e-Jamhuriat, G-5/2, Islamabad* |

| | |
|---|---|
| 1220 hrs | 2. The Role of D.o.S.T. in Promotion and Creation of Job Opportunities: through various Development Programmes of Science and Technology in N.W.F.P.<br>*Dr. Khalid Khan, Director, Directorate of S&T (D.o.S.T.), Govt. of N.W.F.P., Peshawar* |
| 1235 hrs | 3. Use of Renewable Energy in the Implementation of 'Clean Drinking Water for All' (CDWA): Project for Health Benefits, Job Creation and Local Ownership<br>*Mr. Ali Kamal, Director, PSDW-HPP, Abt Associates, USAID Contractor, Islamabad* |
| 1250 hrs | Question & Answer Session |
| **1305 hrs** | **Lunch** |

| **1405 – 1605 hrs** | **TECHNICAL SESSION – 6** |
|---|---|
| | **Theme**: ICTs<br><br>**Chairperson: Dr. Arshad Ali**<br>Rapporteur: Dr. Nazir A. Sangi |
| 1405 hrs | 1. Changing Role of Universities in Knowledge Economy<br>*Dr. Arshad Ali, School of Electrical Engineering and Computer Science, National University of Science and Technology (NUST), Islamabad* |
| 1420 hrs | 2. The Importance of University-Industry Liaison for Employment-Generating Programmes in ICTs<br>*Dr. Mohammad Ahsen Mirza, Inch. Office of Industrial Liaison and Professional Development, Department of Electrical Engineering, COMSATS Institute of Information Technology (CIIT), Islamabad* |
| 1435 hrs | 3. Leveraging ICTs in Creating Jobs<br>*Mr. Iqtidar Zaidi, President & CEO, Tech Access, Islamabad* |
| 1450 hrs | 4. ICTs and Employment-Opportunities for Youth and Female Population<br>*Dr. Nazir A. Sangi, Dean of Science, Department of* |

| | |
|---|---|
| | *Computer Science, Allama Iqbal Open University, Islamabad* |
| 1505 hrs | 5. Virtual Employment: Harnessing the Potential<br>*Dr. Shahida Saleem, Chairperson, Standing Committee on IT&T, Federation Pakistan Chamber of Commerce and Industry, Karachi* |
| 1520 hrs | 6. Role of PTA as a Facilitator of the Telecom Sector<br>*Dr. Khawar Siddiqui Khokhar, Member (Tech) Pakistan Telecommunication Authority (PTA), Islamabad* |
| 1535 hrs | 7. Self-Employment in ICT: Issues and Opportunities<br>*Prof. Bhawani S. Chowdhry, Director, Institute of Information and Communications Technologies, Mehran University of Engineering & Technology, Jamshoro* |
| 1550 hrs | Question & Answer Session |
| **1605 hrs** | **Panel Discussion** |
| **1700 – 1800 hrs** | **CONCLUDING SESSION** |
| 1700 hrs | Recitation from the Holy Quran |
| 1705 hrs | Concluding Remarks by Dr. Anwar Nasim, Adviser Science, COMSTECH Secretariat, Islamabad. |
| 1710 hrs | Vote of Thanks by the Participants/Speakers |
| 1715 hrs | Vote of Thanks by Mr. Tajammul Hussain, Director General (International Affairs), COMSATS Secretariat |
| 1720 hrs | Distribution of Certificates |
| 1730 hrs | Refreshments |


Group Photo of the Participants of National Seminar on
Policies and Strategies for Successful Implementation of Employment Generating Programmes in
Renewable Energies, Biotechnology, Agriculture, Environment and ICTs (August 11, 2009)

# INAUGURAL SESSION

# INTRODUCTORY REMARKS

**Dr. Imtinan Elahi Qureshi**
*Executive Director COMSATS*

Dr. Ishfaq Ahmad, Advisor Planning Commission
Prof. Dr. Atta-ur-Rahman, Coordinator General COMSTECH
Participants of the Seminar, Distinguished Guests
Ladies and Gentlemen!

Assalam-o-alaikum

It is my pleasure and honour to welcome you all, on behalf of COMSATS, COMSTECH, HEC and myself. I am particularly happy that COMSTECH and COMSATS have joined hands, with the support of the Higher Education Commission of Pakistan (HEC), to focus on an issue that sits at the core of economic revival but is given relatively less attention while formulating development plans in Pakistan. It is our sincere desire to put a spotlight on the issue of employment generation through this seminar.

I think it is fair to say that for any country, the health of its economy is best gauged by looking at the number of people who are gainfully employed and participating in the economic activity, in the production as well as service sectors. It is, therefore, not surprising that every where in the world, whenever major investments are made or new economic policies and plans are formulated, the main justification comes from how these would affect employment opportunities. To be unemployed is not simply a matter of losing money to support oneself and one's family, it goes even beyond, to the level where the individual concerned develops inferiority complex and becomes a social liability. Unemployment is a social stigma that erodes self-respect, degrades social standing and degenerates the human psyche, sometimes leading to anarchistic behaviour. Rampant unemployment is a menace that wastes the nation's resources, slackens competitiveness and generally cripples the economy of a country. In short, it is at the heart of the malaise that weakens a society and obstructs its development. What is then more important than addressing this curse, up-front, and alerting the nation to its perils. In principle, it is a matter of concern for the policy-makers to see how the nation's workforce is usefully employed. However, the academic community and intelligentsia bear the responsibility to do the needed analytical work and come out with viable solutions that the authorities concerned can take up for implementation. This is what this seminar is supposed to achieve, while focusing on some of the most promising areas of technologies contained in the long title of this seminar.

In industrialized countries, the state of the national economy is invariably judged by the rate of inflation and the current rate of unemployment. The availability of authentic

data serves as a key element of corrective measures, wherever needed. In Pakistan, the matters are worse because, often, the data is unavailable or unreliable. A major part of economic activity is informal, unregulated and un-documented. Also, there are societal aversions to menial jobs and gender equality. However, Pakistan's remarkable asset is its young population (over 60% are below the age of 25). The public-sector businesses attribute their low international competitiveness to the lack of adequate facilities, such as power and infrastructure. In this regard, the government is not only faced with the "trade deficit"; it also confronts a "trust deficit", although there are undoubtedly certain circumstances beyond the control of the Government that limit its freedom of action. The challenges that we face can only be addressed by participatory roles of all segments of the society – both public and private. It is futile to identify scapegoats in the arenas of political set-up or civil and military services; all influential members of the society bear the responsibility for our present predicament. To turn things around, if we earnestly so wish, we need to look no farther than our own sphere of expertise. Every individual can make a difference or at least every individual can have the satisfaction of knowing that he has tried to make a difference. It is to be understood that when calamities strike the nations, no individual is spared and no individual is exonerated of responsibility. It is, therefore, not a matter of academic interest of what we can do to put our house in order – it is truly a matter of life and death – of survival or annihilation.

If we look around in the world, we see that the detractors of Pakistan are propagating their wishful omens of an irreversible slide towards a failed-state status; of unprecedented civil strife and economic setbacks. Only we can prove them wrong – not through words but actions on-ground that speak for themselves, showing our resilience and capacity to confront challenges and defeat adversaries.

Those of you who have spared time to join us for this 2-day seminar deserve the highest appreciation, because you have responded to a call for sharing your thoughts and knowledge on a matter of vital importance for the nation. We are grateful to all of you, who have come from universities, research organizations and industries. Your collective wisdom and diverse experiences in various fields of Science and Technology would enrich the deliberations of this seminar and will hopefully affect the national policy-decisions. The proceedings will also be published, to create a permanent record for educational purposes.

There are those among our scientific community who take a less favourable view of the merit of symposia and the need to generate public debate on key issues of national development, through discussions among the stake-holders, dismissing these activities as occasions to socialize. This is an extreme view; however, there is a genuine concern for a need to follow the process of "thoughts and analysis" to a stage of "planning and actions". From thought to reality, there is a long chain. Each segment of this chain is important and should not be degraded in any way. Actions without planning are as wasteful as the discussions for the sake of discussion are meaningless. Neither COMSATS nor COMSTECH are scientific research organizations. These are

the forums that facilitate scientific and technical enterprise in their respective member countries. Their mandates obligate them to provide leadership for making science and technology a vehicle of socio-economic progress. This objective is achieved through a variety of capacity-building mechanisms, including the organization of workshops and symposia that bring together academicians and intellectuals, and provide the insight and analysis that serve as guidelines for future actions.

As far as COMSATS is concerned, it has currently a membership of 21 countries, spread across 3 continents and having populations of diverse religious affiliations. COMSATS has also a network of 16 Centres of Excellence. These Centres are the national R&D organizations; however, by virtue of their membership of the Network, they provide necessary resource to COMSATS for undertaking its major role of South-South cooperation. In Pakistan, the COMSATS Institute of Information Technology (CIIT) and International Center for Chemical and Biological Sciences (ICCBS) are affiliated to COMSATS as the Centres of Excellence. CIIT is also one of the two flagship projects of COMSATS in Pakistan, the other being COMSATS Internet Services (CIS). CIIT is well-known to be a major public-sector university, with over 16,000 students and six campuses in Capital Territory, the Punjab and NWFP. Other less known but very important projects of COMSATS in Pakistan are related to tele-health and distance learning programmes. Internationally, COMSATS has set-up an IT Centre in Syria, and provided training facilities to young scientists of member States in its Centres of Excellence including CIIT. There are 100 scholarships available for post-graduate education at CIIT for students of member countries.

COMSATS has very little funds for its operations. However, innovative ways are employed to fulfill its mission, particularly through collaboration with organizations having similar objectives and adequate financial resources. Thus we have, in the past, undertaken joint activities with UNESCO and ISESCO; COMSATS is playing an important role on behalf of ISESCO by creating and maintaining a portal called "Islamic World Science Net" (IWSN). Recently, it was expanded to include a network of Thematic Groups in selected areas of technologies. Through this portal, scientists in OIC member states can interact with their peers working in common areas of research. Making use of this occasion where people with diverse scientific backgrounds are represented, I invite you all to become members of one of the following groups:

- New and Renewable Energy;
- Bio Sciences/Bio-technology and Genetic Engineering;
- Bioethics;
- Environment;
- Mathematics;
- Water Management;
- Nano-Technology;
- ICTs in Science and Technology; and
- Science Academies.

You can request for log-in authorization by writing to web-administrator of www.iwsn.info.

In the end, it is my honour to thank COMSTECH for organizing this seminar with the participation of COMSATS and HEC, on a topic that is relevant and urgent in the current economic situation of Pakistan. I am indeed extremely grateful to all participants and I have no doubt that the presentations that will be made and the discussions held would provide a rich resource of reference material. I should thank all the organizing-committee members, both from COMSATS and COMSTECH, in particular Dr. Anwar Nasim and Mr. Tajammul Hussain, who have worked hard to make this seminar possible.

I wish you all a fruitful and enjoyable meeting.

Thank you.

**Glimpses of the Inaugural Ceremony**

# Renewable Energy Technologies

# EMPLOYMENT OPPORTUNITIES IN RENEWABLE ENERGY SECTOR OF PAKISTAN

**Irfan Yousuf**
*Deputy Director (CDM & Environment)*
*Alternative Energy Development Board (AEDB), Islamabad*
Email: irfanyousuf@aedb.org

**ABSTRACT**

*The current energy-crisis has brought historical employment-deficiency in the country. Due to energy shortfall, most of Pakistan's industries are shutting down or not working full hours. This is causing huge employment crisis in the country. A clear remedy is to look towards alternative sources of energy, i.e. the renewable energy sources.*

*Currently, it is hard to find renewable energy experts in Pakistan. However, development of renewable technologies, initiation of projects, flourishing of the sector and setting up of new industries will create huge prospects for employment in the renewable energy sector. The quest to produce more renewable energy and use it more efficiently will create a need for skilled workers. In this challenging time of economic meltdown, this will both help to produce jobs as well as help in the creation of green technologies to burgeon.*

*Renewable energy sector is huge and a large variety of professionals can be accommodated in this industry. According to the European Commission, renewable energy could generate about 2.8 million jobs. The energy industry attracts a large number of job-seekers for various types of jobs. Jobs in the field of sustainable energies are already gaining momentum. Some renewable energy sectors like wind, hydropower, solar, etc., have already started generating jobs. Execution of projects by private project sponsors will result in flourishing the renewable energy sector. Open avenues for the industries to start manufacturing locally and this would boast development of industrial set ups. Industries like cement, steel, electrical cables, appliances and power transmission equipment manufacturers, transportation sector, services sector, construction material suppliers etc., are likely to benefit directly from such projects. Generation of power and its induction into national grid, is also likely to benefit the production and commercial sectors.*

## 1. INTRODUCTION

Electricity is in great demand in Pakistan due to recent economic and industrial growth in the country. Since the Government of Pakistan (GoP) had been unsuccessful in initiating mega power projects to meet the increasing energy demands, the country is facing acute shortages of electricity. Accordingly, the key planners have chalked out

various projects to harness conventional, as well as non-conventional energy resources for power generation. Commencement of infrastructure-development projects, such as energy projects usually creates various business development opportunities in different sectors. This, in turn, results in creation of employment-opportunities for the individuals, professionals, workers, and skilled and un-skilled labour. The key economists say that there is a clear relationship between "MW installed" and "number of jobs". Such development creates both direct and indirect employment opportunities. Direct jobs relate to employment in manufacturing companies and with sub-contractors whose main activity is to supply wind-turbine components. Also included are promoters, companies selling electricity from wind-energy and major R&D, engineering and specialized energy services. Any companies producing components, providing services or sporadically working in related activities can provide indirect employment.

## 2. ENERGY CRISIS IN PAKISTAN

Pakistan is currently facing its worst energy crisis ever. Lack of vision and integrated planning on part of policy-makers are mainly responsible for this crisis. Current annual power shortfall is 4,000 MW, plus 2,000 MW additional capacity required annually to maintain the current GDP growth-rate with an investment of US$ 4-6 Billion per year. So, the energy supplies must increase to 40% of current levels by 2010 and to 80% by 2015.

## 3. ENERGY SCENARIO OF PAKISTAN

Pakistan's energy requirements are potentially huge; it is the sixth-largest country in the world, with its growing population that is expected to exceed 190M by 2015. The GDP growth remained below 4% in the previous two years, although the Government is targeting a high average annual GDP growth upto 7%, in its projections in the medium term. Rising population, incomes, per-capita energy use, and industrialization translate to high energy-demand growth (total primary energy supply expected to triple or quadruple by 2025). The increased energy-demand would call for setting up of new power plants. Currently, serious economic and development implications are being faced due to energy-deficit in Pakistan. To meet these requirements, increasing energy-import costs, with few medium-term solutions to supply shortfalls, are expected to be faced. This calls for utilizing indigenous and readily available energy-resources, wherein renewable energy comes up as the most appropriate choice.

### 3.1 Pakistan's Primary Energy Supply

Figure-1 gives a view of Pakistan's current primary energy supplies. It is anticipated that, in the medium term, Pakistan's energy imports are to rise sharply due to increased demands.

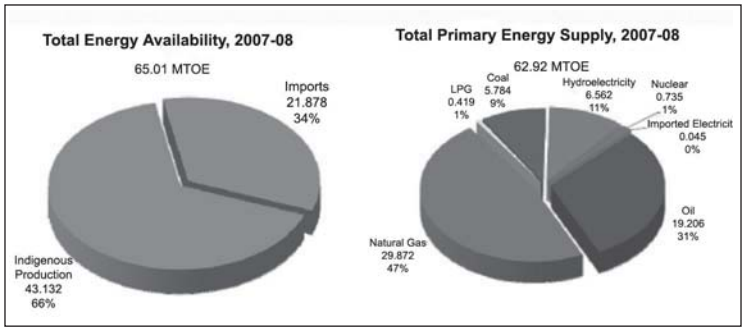



**Figure - 1: Pakistan's Primary Energy Supplies**

### 3.2 Pakistan's Energy Demand

Industry, transportation, and domestic sectors represent 92% of Pakistan's energy consumption (Figure-2). Due to rapid growth, industrialization, social uplift and increase in per-capita energy-consumption, the demand is going to increase in these sectors to a large extent.

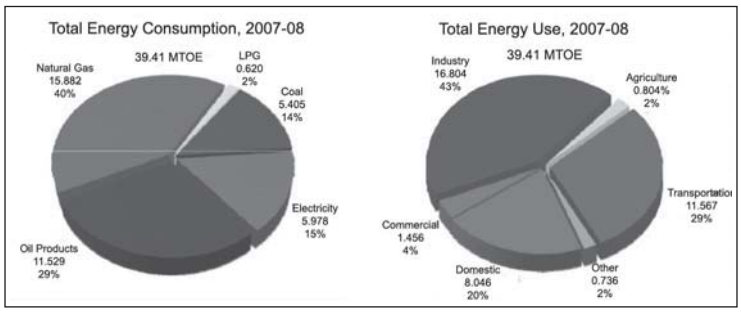



**Figure - 2: Pakistan's Total Energy Demand**

### 3.3 Pakistan's Energy Deficit

Pakistan's growing energy-deficit has large potential economic impact; crude oil imports have grown on the average by 3.4% annually in the last five years. Electricity-use has increased by 7% annually over 2003-08, with generation-growth lagging at 4.8% over the same period. System-wide T&D losses are still high at 24.8%. Serious power shortages that started in 2007-08 are expected to continue till 2010, at least. To maintain 8% annual GDP growth, a minimum of 12% increase in TPES and 8% growth in power-generation is required each year till 2015. The question is how best to manage this.

### 3.4 Why Renewable Energy

Pakistan is blessed with good resources of renewable energy. Wind, solar, hydro,

biomass/biowaste, tidal, wave, fuel cell, geothermal, geo-magmatic bio-fuels, etc., all have prospects for development in Pakistan. Being indigenous, environmentally clean, readily available and technically viable, renewable energy resources become the most prolific choice for meeting energy needs. Renewable and alternative energy can help to:

i. Improve energy security, by substituting imported energy with inexhaustible indigenous resources;
ii. Provide lower-cost supplies and additional socio-economic benefits;
iii. Help reduce local pollution and mitigate climate-change;
iv. Provide dispersed supplies near demand centres, reducing T&D losses and improving access in remote regions;
v. Displace harmful traditional biomass-burning and help alleviate rural poverty.

## 4. ENERGY MARKET IN PAKISTAN

Pakistan has seen GDP growth rate of 7%, even though, it has recently gone down to around 4% due to security issues, financial crunch and global recession, but it is expected that the economical growth would again rise up. It is expected that this would lead to yearly increase in energy demand of 8-12%. Current total installed power capacity in the country is around 19,522 MW. Based on the growth in energy-demand, it is projected that the energy-demand would reach upto 162,590 MW by 2030. The government is taking every possible measure to overcome the current energy crisis, and relentless efforts are under way to bridge the gap between demand and supply of electricity.

Several projects are being initiated to not only bridge the energy deficit, but also meet future energy-requirements. Renewable energy forms provide excellent prospects for power generation and development in Pakistan. The promotion and development of renewable energy is not only a priority area for the Government, but it has also figured prominently on the policy-plans of the government.

### 4.1 Overview of Electrical Energy Sector

A bird's eye view of the energy mix of the country indicates that it includes the following supplies:

- Total Installed Capacity — 19,564 MW
- Thermal (fossil-fuels) — 12,567 MW (64% share)
- Hydel — 6,493 MW (33% share)
- Nuclear — 462 MW (2% share)
- Renewables — 42 MW (new addition since 2008)

### 4.2 MTDF Projections

The Government is not only trying to meet the current energy-demands, but is also planning to fulfill future energy-needs of the country. In this perspective, an integrated energy-plan is being carried out. In this activity, the following projetions are made:

- Power Generation Plan (2015)
  - Addl. Capacity addition: 20,000 MW
  - Thermal Share: 11,000 MW
- Power Generation Plan (2030)
  - Total Projected Capacity: 162,590 MW
  - Thermal Share: 111,000 MW

### 4.3 Renewable Energy Potential in Pakistan

Pakistan is one of these countries of the world that have excellent potential of renewable energy. This gives huge prospects for development of renewable-energy resources to meet increasing energy-needs of the country. The renewable energy potential is summarized below:

| | |
|---|---|
| Wind: | 0. 346 Million MW |
| Solar: | 2.9 Million MW |
| Bagasse Cogeneration: | 1800 MW |
| Waste to Power: | 500 MW |
| Mini & Small Hydel: | 2,000 MW |
| Geothermal: | 550 MW |

**Source:** *USAID / SARI-E Project, June 2007*

Gharo-Keti Bandar wind-corridor is regarded as one of the best sites for wind power projects, having an identified potential of 50,000 MW for wind alone.

### 4.4 MTDF Projections (Renewables)

The Medium-Term Development Framework (MTDF) has given special emphasis to development of renewable energy in the country. The projections given therein for development of renewable energies for power generation are as follows:

- Power Generation Plan (2015)
  - Addl. Capacity addition: 20,000 MW
  - Renewables Share: 800 MW

- Power Generation Plan (2030)
  - Total Projected Capacity: 162,590 MW
  - Renewables Share: 9,700 MW

## 5. POTENTIAL AND DEVELOPMENT OF RENEWABLE ENERGY

In this section, the potential of various forms of renewable energy is discussed in detail. This section also indicates the current developments in renewable energy sector in Pakistan.

### 5.1 Wind-Energy Development

#### *5.1.1 Wind-Energy Potential in Pakistan*

National Renewable Energy Laboratory (NREL), Colorado-USA, in collaboration with United States Agency for International Development (USAID), Pakistan Meteorological Department (PMD) and Alternative Energy Development Board (AEDB), has carried out a detailed analysis to determine wind-energy potential in various regions of Pakistan. Based on the data available from PMD meteorological sites and the satellite imagery data, NREL has developed a wind-map of Pakistan (Figure-3). The wind-map of Pakistan developed by NREL indicates that major wind- resource areas are located in south-eastern Pakistan, northern Indus valley, south-western Pakistan, central Pakistan and elevated mountain summits and

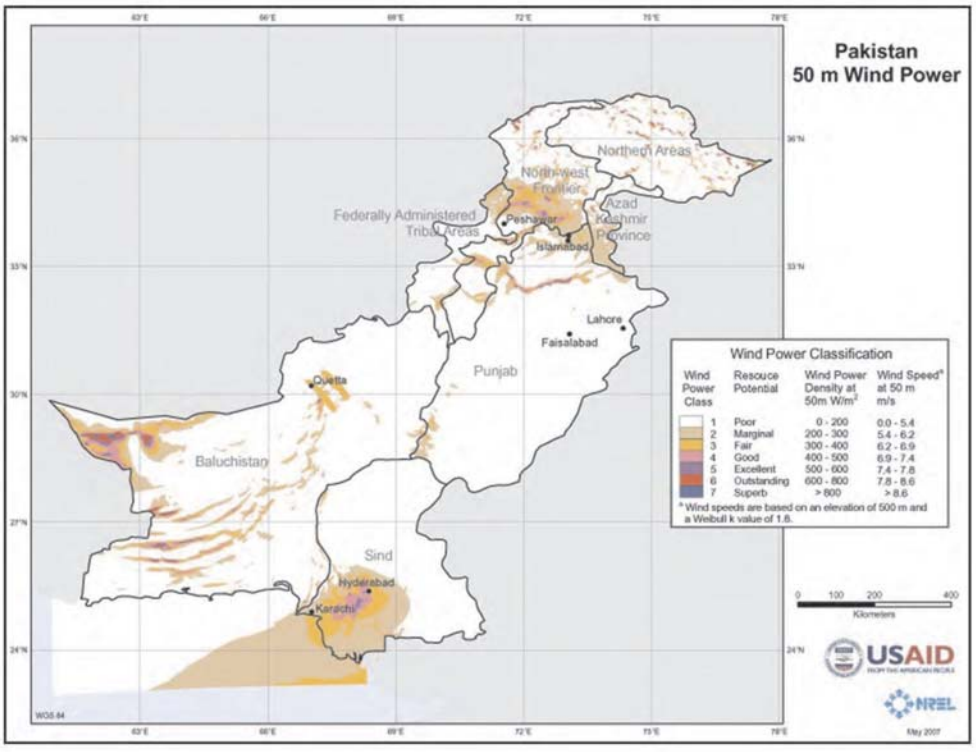



**Figure - 3: Pakistan's Wind Energy Potential at 50 m Height**

ridge crests, especially in northern Pakistan. Among these, south-eastern Pakistan, especially the Gharo ~ Keti Bandar Wind Corridor, spreading 60 km along the coastline and more than 170 km deep towards the land, is considered to be highly suitable and most appropriate for setting up of wind projects. This outcome is based upon the facts that:

- Large acreage of government land is available in the area.
- The land is barren and there is no other utilization of this land.
- The terrain is flat and there are minute or negligible constraints and obstacles related to the wind in the area.
- The roughness of the land is very low and climatic conditions are very moderate.
- Access through land and sea is very easy. Transportation of wind-turbine generators, necessary equipment and machinery is much economical.

Based on various studies conducted by various agencies, like AEDB, NREL, USAID, PMD and UNDP, it is anticipated that the Gharo ~ Keti Bandar Wind Corridor has a potential to generate more than 60,000 MW of electricity.

### *5.1.2 Government Incentives for Wind-Farm Investors*

The government could provide the following incentives to wind-farm investors:

- Attractive cost of land for wind-energy projects (€5 per acre per year);
- Pre-feasibility has been done by AEDB;
- Wind data measured, analyzed and wind-risk for the first few projects taken by Government;
- Development of Benchmark wind of speeds for Gharo ~ Keti Bandar Wind Corridor;
- Tariff to be calculated on the basis of capacity plus energy payments;
- Upfront tariff of US cents 9.5 / kWh offered by NEPRA;
- 15% Return on Equity (ROE) guaranteed, as per NEPRA guidelines;
- Announcement of attractive and investor-friendly Renewable Energies Policy 2006;
- Development of standardized project-documents, keeping in view the norms of international wind-industry.

### *5.1.3 Current Developments & Future Targets*

- On-grid projects are still to come on-line; government is seeking to develop this sector through private investment. Ninety five investors have been given LOIs for setting up wind power projects (92 for 50 MW each, 2 for 100 MW each and 1 for 5 MW). 500 MW of wind power would be generated in the next five years. Such initiatives will lead towards attaining target of commissioning 9,700 MW by 2030.

- International Power Producers (IPPs) are being attracted to execute their wind- power projects in Gharo Wind Corridor. At present, AEDB has allocated land to 23 wind-power projects, each of 50 MW capacity. Out of these, 12 projects have completed their feasibility studies, 9 have applied for generation license, 4 have applied for tariff determination and 3 are in the process of negotiating their Energy Purchase Agreements (EPA) and Implementation Agreements (IA) with the concerned authorities. Zorlu Enerji Pakistan Ltd (NEPRA awarded tariff of US cents 12.1057 / kWh that was accepted by the company) has commenced execution of its 50 MW wind power project in Jhampir, Thatta (Figure-4). Its first phase of 6 MW was completed by the first week of February 2008 and COD of full project would be achieved by the end of this year. Three companies have acquired land from private sector for their 50 MW each wind-power projects and are in process of completing their feasibility studies.
- Off-grid projects have been undertaken by AEDB and PCRET. AEDB has electrified 18 villages in coastal areas of Sindh and Balochistan. Further extension plans are underway. PCRET also has electrified 3 villages in Sindh.
- Net metering is being done by one investor in Karachi, by installing 225 kW wind- turbine in Landhi. Few more such proposals are underway.
- Some private investors are also seeking to benefit from wheeling facility.


**Figure - 4: Site of Zorlu Enerji Power Project**

## 5.2 Solar Energy Development

### *5.2.1 Solar Energy Potential in Pakistan*

National Renewable Energy Laboratory (NREL), Colorado-USA, in collaboration with USAID, PMD and AEDB, has carried out a detailed analysis to determine solar-energy potential in various regions of Pakistan and has prepared solar maps of Pakistan. These solar maps indicate that:

- Pakistan lies on a sunny belt.
- The mean global irradiation, falling on horizontal surface, is about 200-250 watt per $m^2$ per day.
- About 1,500-3,000 sunshine hours and 1.9 - 2.3 MWh per $m^2$ per year.
- Balochistan, particularly, is rich in solar energy. It has an average daily global insolation of 19 to 20 MJ/$m^2$ per day, with annual mean sunshine duration of 8 to 8.5 hours a day, and these values are amongst the highest in the world. For daily global radiation up to 23 MJ/$m^2$, 24 consecutive days are available in this area.
- Benefits of solar energy for power-generation can be attained in areas where abundant barren land is available and no other development activities, like agriculture, livestock, industry, etc., are possible.

### *5.2.2 Current Developments & Future Targets*

- Two demonstration solar-thermal power units have been installed, each of 8 KW capacity, but are in R&D stage. In the long term (by 2020), it is planned to generate about 500 MW through solar-thermal power plants. Two investors have shown their interest to initiate solar-thermal power projects, but these are at proposal stage, whereas two others have shown interest to execute solar PV power projects.
- AEDB has so far electrified 1,762 houses in 31 villages, through solar photovoltaic all over the country, work is in progress for electrification of 3,000 houses in Sindh, whereas electrification of 12,000 houses in Balochistan is in the pipeline. As per plan, AEDB has to electrify 906 and 6964 villages in Sindh and Balochistan, respectively.

## 5.3 Micro ~ Mini ~ Small Hydro Power Development

### *5.3.1 Potential in Pakistan*

The identified potential for hydel power at this level is given in Table-1.

### *5.3.2 Current Developments*

- AEDB is looking forward to the private sector for commencement of projects in Micro/Mini Hydro. One such project of 4 MW capacity is near completion in

**Table - 1: Micro~Mini~Small Hydro Power Potential in Pakistan**

| S # | Province | No. of Potential Sites | Potential Range (MW) | Total Potential (MW) | Remarks |
|---|---|---|---|---|---|
| 1. | North Western Frontier Province | 77 | 0.02 ~ 32 | 426.41 | Small Dams, Natural Falls |
| 2. | Punjab | 306 | 0.02 ~ 40 | 349.6559 | Canal Falls |
| 3. | Northern Areas | 136 | 0.1 ~ 38 | 814.15 | Natural Falls |
| 4. | Sindh | 10 | 0.5 ~ 40 | 98.05 | Canal Falls |
| 5. | Balochistan | NA | NA | 0.55 | NA |
| 6. | Azad Jammu & Kashmir | 24 | 0.2 ~ 40 | 177.00 | Natural Falls |
| | **Total** | **546** | **0.02 ~ 40** | **1865.8159 MW** | |

**Source:** *Private Power Infrastructure Board, Pakistan Hydel Power Potential (2004)*

NWFP. Execution of other 16 MW mini-hydel projects will be executed in next few months. As pilot project, AEDB also installed two Kaplan Turbines of 40 kW each in Taxila, Punjab. Pakistan Council for Renewable Energy Technologies (PCRET) has so far installed MHP plants of capacity-ranges from 5 kW to 50 kW in the Northern Areas and NWFP, and seventy two more such turbines will be installed by 2009. Now, the Council is working for development of Kaplan Type Turbines for harnessing low-head hydel potential.

Under the Renewable Energy Development Sector Investment Programme

**Table - 2: Sites in Punjab where Small & Mini-hydel Projects are Initiated**

| | | |
|---|---|---|
| Olympia Chemical, B.S. Link Canal | Small Hydel | 10 MW |
| Deen Power, Q.B. Link canal | Small Hydel | 7.71 MW |
| Alka Power (Pvt.) Ltd., Jhang Brach Canal | Mini Hydel | 3.03 MW |
| Alka Power (Pvt.) Ltd., L.B.D.C | Mini Hydel | 2.08 MW |
| Haseeb Khan & Co., C.J.Link Canal | Small Hydel | 40 MW |
| New park Energy Ltd., T.P.Link Canal | Small Hydel | 10 MW |
| New park Energy Ltd., B.S.Link 1 | Small Hydel | 9 MW |
| Habib Rafiq (Pvt.) Ltd., Rasul | Small Hydel | 20 MW |
| Habib Rafiq (Pvt.) Ltd., Punjnad | Small Hydel | 20 MW |
| Olympus Energy (Pvt.) Ltd., Marala | Small Hydel | 20 MW |

(REDSIP) of Asian Development Bank, the AEDB, in collaboration with provincial governments of Punjab and NWFP has initiated 8 micro ~ small hydro power projects for 80.1 MW electricity production.

Besides this, 10 projects of 141 MW capacity were initiated in Punjab (Table-2). Feasibility study of one project of 30 MW is being initiated at Kotri through private sector.

**5.4 Biomass Waste to Energy Development**

This technology has enormous potential in Pakistan. A lot of energy can be generated through the available resources. Being an agricultural country and having a large number of livestock, the prospects of this technology available in Pakistan are described below:

***5.4.1 Bio-Energy Potential in Pakistan***

*i. Bio-gas Plants based on Cattle Dung*

| | | |
|---|---|---|
| Total No. of Cattle (Buffaloes & Cows) | 51 million | |
| Daily Dung @ 15 kg per animal | 765 million kg | |
| Biogas Production | 30.6 million cubic meter/ day or | |
| | 11,169 million cubic meter / annum | |
| This can replace | 4,840 million kg LPG | OR |
| | 6,888 million litre of Kerosine Oil | OR |
| | 18,243 million kg of Charcoal | OR |
| | 62,360 million kg of Wood | OR |
| | 137,751 million kg of animal dung | OR |
| | 55,845 million kWh | |

*ii. Biomass Consumption in Household Sector (***Source:** *HESS Report, 1993)*
*(a) (Direct Combustion in Conventional Stoves)*

The present situation is:

| | |
|---|---|
| Wood fuels | 54% |
| Dung | 18% |
| Crop residue | 14% |

(b) Sugar Industry in Pakistan is capable of producing around 700 MW power, by means of bagasse-based biogas power projects. In addition to that, the country has immense potential for power-generation through biomass and waste-to-energy projects. AEDB is in the process of conducting feasibility studies, to determine the exact potential of such technologies in Pakistan, e.g.

- Sugar industry has a potential of producing approximately 2,000 MW power, using Bagasse during sugarcane season.
- Agricultural waste, like wheat straw, rice husk, etc. Is also readily available in Pakistan, which has potential of power generation.
- Every major city of Pakistan has a sizeable potential to generate energy from municipal waste-materials.

*iii. Bio-fuels*

Both bio-diesel and ethanol have good prospects for development in Pakistan. Plants, like Jatropha, Pangomia, Castor, etc., have been cultivated in different areas. The cultivation, however, has been sporadic and was not intended for production of bio-diesel, whereas sugar mills have been producing ethanol as a byproduct. Therefore further organization of the cultivation is needed.

### *5.4.2 Current Developments*

- Harnessing of biomass power projects is in progress: 35 MW of electricity is being generated using biogas. Two companies, i.e. Shakarganj Sugar Mills (7 MW biogas-to-energy project) and Al-Moiz Energy Ltd. (15 MW Biogas-to-energy project), are commissioning projects to sell 22 MW of surplus/spillover power to the national grid. Both these projects are based upon bagasse. The developments for harnessing this energy-resource are in process.
- Karachi Cattle-Colony Project of 21 MW is the first of its kind in Pakistan. Its construction is near commencement. Pilot-phase of Landhi Cattle-Colony Biogas Project has been completed.
- AEDB has issued LOIs to 6 other private companies for waste-to-energy projects. Some private industries, like Sugar Distilleries, are using bagasse for power- generation for self-use. A few proposals have also been approved for generation of on-grid power through bagasse.
- Three new Waste-to-Energy Projects awarded with Generation License by NEPRA viz. Indus Sugar Mills Rajanpur 11MW; Ghotki Sugar Mills 12 MW; JDW Sugar Mills Rahim Yar Khan 22 MW.
- Four new Waste-to-Energy applications pending with NEPRA (Ramzan Sugar Mills Chiniot 12 MW; Ashraf Sugar Mills Bhawalpur 8 MW; Thal Energy 10 MW; Shakarganj Sugar Mills 20 MW).
- Waste-to-Energy Study, worth US $ 325,000, initiated for Karachi city to generate 10 MW power.
- District governments of Lahore, Faisalabad and Karachi have given tenders for generation of power through waste-to-energy power plants.
- Installation of commercial biogas plants, of capacity 50 $m^3$ to 500 $m^3$ at cattle and poultry farms in different cities is also under consideration.
- Preliminary research-studies have been carried out on bio-diesel resources in Pakistan. AEDB is now looking forward to carrying out detailed technical study of bio-diesel that would lead to the establishment of bio-diesel

production plant in the country.

- GoP has already set the targets for production of bio-diesel in Pakistan and is intending to replace 5% of the total annual diesel consumption by 2015 and 10% by 2030 by bio-diesel.
- Policy recommendations for use of biodiesel as an alternative fuel was issued.
- Study for setting up biodiesel facility (upto 10,000 tons per annum) initiative is currently under approval.
- Duty-free import of equipment and specific items used for production of biodiesel has been allowed.
- Amendments in OGRA ordinance for regulation of biofuels have been finalized with Cabinet Division.
- Pakistan State Oil Company Ltd. (PSO) has been successfully engaged in and is producing biodiesel on a limited scale. PSO has also set up a Jatropha Nursery and a Jatropha Model Farm at its installations in Karachi.

### 5.5 Remote Village Electrification

- Demonstration project of 100 solar homes at Narian Khorian has been completed, and was inaugurated by the Prime Minister in June 2005.
- Pilot-project of 100 solar homes in each province was completed.
- A total of 1,762 homes have been electrified in 31 villages so far, in all four provinces of Pakistan.
- 7,874 off-grid villages are planned to be electrified by AEDB in Balochistan (6,968) and Sindh (906).
- 15,000 houses of 400 villages (300 in Balochistan and 100 in Sindh) are going to be electrified in the 1st phase of the programme.
- 2,500 houses of 100 villages in Sindh are currently being electrified.
- Approximately 7,874 villages are too far off from the grid and thus cannot be supplied electricity by WAPDA; 400 Villages (300 in Balochistan and 100 in Sindh) are to be electrified in the first phase of NREP's programme.
- So far, more than 4,000 houses have been electrified in more than 65 villages of Tharparkar & Nagarparkar Districts of Sindh.

### 5.6 Energy-Conservation: Alternative Solutions

AEDB is trying to initiate activities that would facilitate energy-conservation. On the recommendations of AEDB, the Prime Minister issued the following directives:

- All new Public Lighting (street lights/park lights) and Billboard/Neon Sign Lights should be run on solar energy.
- All existing public lighting (street lights / park lights, etc.) and Billboard/Neon Sign lights should be converted to solar-based LEDs in a phased manner (Figures 5 & 6).
- All Public Sector Buildings to meet 5% of their energy-requirements through solar energy and this should be increased to 10% in 2nd phase and 20% in 3rd phase

**Figure - 5: Efficient LED Street Lights**

**Figure - 6: High-Intensity Search-lights**

**Figure - 7: Demo Solar Powered Lights, Installed at P.M. Secretariat, Islamabad**

(Figure-7).

- All public-sector buildings (beginning with the Federal Capital) should use solar water- heaters instead of gas-lit geysers.
- All new public-sector buildings to be constructed as energy-efficient "Green Buildings".

### 5.7 Other Alternative-Energy Technologies with Good Resource Potential

Other potential areas that can be harnessed and have a potential for power-generation, in Pakistan, include the following:

- Solar Thermal;
- Ethanol;
- Wave Energy;
- Tidal Energy;
- Geo Thermal; and
- Geo-Magmatic.

## 6. VIABLE OPTIONS OF RENEWABLE-ENERGY APPLICATIONS IN PAKISTAN

### 6.1 Viable Renewable-Energy Applications

Renewable energy technologies have proven to be very effective and a best option for provision of electricity, solution for energy demands of the dwellers of the remote areas. These technologies have the potential to be harnessed and replicated for different purposes. Seeing the renewable-energy potential in Pakistan, it is envisaged that most of their applications that are being used around the world should also be made available in the country. The most promising applications are listed below:

a. On-Grid Power Generation;
b. Net Metering;
c. Wheeling;
d. Captive Power Generation;
e. Off-Grid Electrification;
f. Commercial Lighting;
g. Water Pumping;
h. Water Irrigation;
i. Water Heating;
j. Water Desalination; and
k. Vehicular fuel.

### 6.2 Challenges in Harnessing Renewable Energies

Renewable Energies, though having definite prospects for development, are facing challenges that have transpired into slow progress in developing and adapting such technologies. A few of these challenges are given below:

- Resource assessment of alternative/renewable energies in the country;
- Development of apt tariff mechanism for alternative / renewable energies;
- Grid integration and interconnection issues of on-grid renewable energy projects;
- Insufficient research & development activities in renewable energy sector;
- Certification system for renewable energy products;
- Lack of appropriate human resource;
- Lack of awareness and general acceptance of renewable energy technology for domestic & commercial applications.

Connected with this an appropriate human resource is one of the biggest issues that the renewable-energy industry is facing now a days. As never before, our economic prosperity is dependent on our ability to generate enough energy that would suffice to meet the demand in the country. Renewable-energy development is picking up pace, as these provide an apt and the most economical energy solution in the long run. However, for maintaining a sustainable development phase in this sector, it is imperative that an adequate human-resource pool should be developed within the country. Currently, the market has to rely on professional manpower from abroad, which would be having retarding impacts on the sector in the long run. In order to cope with this issue, we need to fully use our talented professionals and workers and get them trained, to bridge the human-resource gap. A useful step in fully utilizing our labour resources would be to develop a realization that the labour market is changing and the industries related to renewable energy are gaining momentum.

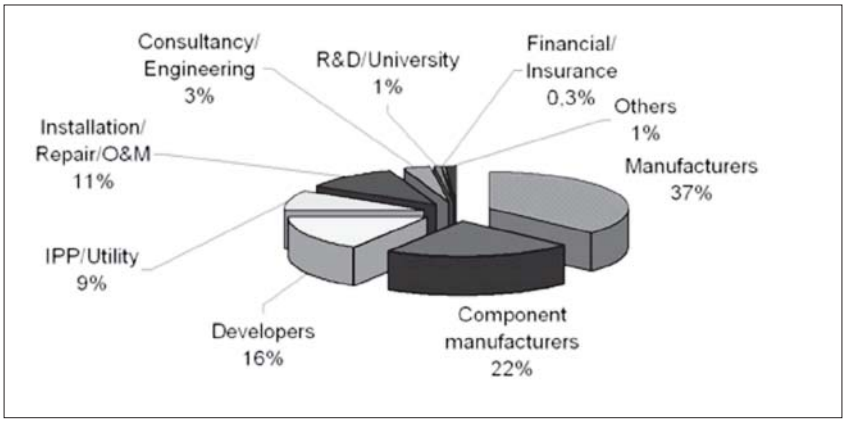
### 6.3 International Scenario: Employment Generation in Renewable- Energy Sector

The renewable-energy sector has shown remarkable progress in various parts of the world. This sector has been regarded as one of the most employment-intensive sectors during last three years.

Developed nations have set their targets to harness renewable energies and have channeled investment to this sector for initiating research and development of human resource, commencement of projects and adopting new technologies from the renewable-energy and energy-efficient technologies. All these efforts have resulted in creating huge employment-opportunities, like those in Europe. Due to the renewable-energy sector development, it is anticipated that around 2.8 million job-opportunities would be created in the next few years. In USA, with more than US$ 500 billion investment, renewable energy sector is highly considered as "the shift to advanced renewable energy that will create thousands of new jobs, both direct and indirect" (See Figure-8).

Wind energy has seen rapid development in Europe. Wind energy figures of European Union (EU) can be measured against the statistics provided by Eurostat. The energy sector employs 2.69 million people, accounting for 1.4 per cent of the total EU employment. Approximately half this number is active in the production of electricity, gas, steam and hot water. Employment from the wind-energy sector would then make up around 7.3 per cent of that amount; and it should be noted that wind energy currently meets 3.7 per cent of EU electricity demand. Although the lack of specific data for electricity-production prevents us from making more accurate comparisons, this shows that wind energy is more labour- intensive than other electricity-generating technologies. This conclusion is consistent with the earlier research.

Ireland is also focused at dealing with the issue of shortage of engineering skills in renewable energy area. An emphasis is laid on developing human capital, with a view that the sector will provide strong economic growth and job-creation in Ireland in the




**Source:** *According to EWEA Survey*

**Figure - 8: Direct Employment (by Types of Companies)**

years and decades to come.

### 6.4 Opportunities in Pakistan

Execution of renewable energy projects will result in flourishing renewable-energy sector in the country. Renewable-energy sector is sizable and a large variety of professionals can be accommodated in this industry. Execution of renewable-energy projects would open up venues for the industries to flourish and start manufacturing necessary technologies locally. This would boost development of industrial set-ups and hence would create employment for local individuals in the country. So far, R&D is scarce in this sector. Development of this sector will open avenues for research institutes, organizations, departments, laboratories and private sector to initiate modern research activities.

A brief on how the sectoral development can take place and employment opportunities can be created by introduction of this new sector, is as follows:

- *Development of Energy Sector, both in Public & Private Sectors*
  - Renewable-energy sector is still in its infancy and lacks human resource
  - Large number of professionals are required to support the planned initiatives
  - The sector has capacity to generate employment opportunities

- *Development of Renewable-Energy Equipment-Manufacturing Industry*
  - Wind turbine towers & accessories
  - Turbines & generators (wind, hydro, steam, gas)
  - SHS systems and solar PV Panels
  - Solar-thermal appliances, for both active and passive applications
  - Solar & wind-based commercial, residential and industrial lighting-solutions
  - Vehicle manufacturing industry

- *Development of Related Industries*
  - Cement industry
  - Steel industry
  - Construction material
  - Logistics industry
  - Electrical and electronics industry
  - Paper industry
  - Food industry

- *Development of Service Sector*
  - Consultants (Technical, financial, legal, etc.)
  - Contractors

## 7. CONCLUSION

This paper has indicated that renewable-energy sector has definite prospects for development in Pakistan. As this would be an entirely new sector in the country, its development would create significant employment-opportunities for professionals, as well as for workers. Besides overcoming the prevalent energy-crisis in Pakistan, such projects will be helpful to stabilize the industries and can bring opportunities for the establishment of new industries in Pakistan and, hence, would result in creating job-opportunities for thousands of individuals, both qualified and semi-skilled.

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# RENEWABLE ENERGY AND EMPLOYMENT OPPORTUNITIES IN PAKISTAN

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**ABSTRACT**

*In these days of economic doom and gloom, the major areas of global concern are energy, environment and unemployment. High energy-demand, escalating prices and limited reserves of fossil-fuels, along with concern over adverse effects of their continued consumption, have led the world to consideration of alternative, "clean" energy-sources. Renewable energy is clean, inexhaustible and abundant. Due to inherent advantages, such as mitigation of climate-change, generation of employment, as well as increased energy security and supply, it appears that renewable energies will dominate the world's energy system in future.*

*The development of renewable energy would eradicate poverty and hunger, through employment-generation, increased industrial development, agricultural processing, storage and transport of crops. This article presents an overview of the global energy situation, development and deployment of renewable energy, with particular reference to renewable-energy status in Pakistan.*

## 1. INTRODUCTION

Energy is used by our society mostly in residential, commercial, industrial, and transportation areas. Each area involves significant consumption of energy, which is supplied mainly by burning fossil-fuels. High energy-demand and limited reserves, along with rapid increase in prices of fossil-fuels and concern over adverse effects of their continued consumption, have led to consideration of alternative, clean sources of energy.

High level of unemployment contributes to poverty, discontent, alienation, social unrest, conflict and crime, all of which hinder economic growth and are threats to political stability. Pakistan's present economic set-up does not have the capacity to absorb a large number of people in urban and industrial employment (Table-1). To build stable and sustainable communities, our young adults must have employment opportunities. In this regard, the global consensus is that the rapidly growing renewable energy sector has the capacity that would offer a number of employment

opportunities in future. The development of renewable energy would eradicate poverty and hunger through employment-generation, increased industrial development, agricultural processing, storage and transport of crops.

**Table- 1: Unemployment in Pakistan**

| Age Group | Total (%) | Urban (%) | Rural (%) |
|---|---|---|---|
| 15-19 | 8.558 | 2.683 | 5.876 |
| 20-24 | 9.123 | 3.388 | 5.735 |
| 25-29 | 6.547 | 2.561 | 3.986 |
| 30-34 | 4.399 | 1.643 | 2.756 |
| 35-39 | 3.296 | 1.198 | 2.098 |
| 40-44 | 2.714 | 0.955 | 1.760 |
| 45-49 | 2.494 | 0.871 | 1.623 |
| 50-54 | 2.363 | 0.808 | 1.555 |
| 55-59 | 2.291 | 0.842 | 1.450 |
| >60 | 2.113 | 0.727 | 1.386 |

## 2. RENEWABLE ENERGY AND SUSTAINABLE DEVELOPMENT

The economic development of the society we live in depends heavily on energy. Energy is vital for sustainable development. It is used to generate electricity for a variety of needs, such as domestic, transport, agricultural and industrial. The methods of production, supply and consumption of energy are key issues in sustainable development. The methods have great impact on local as well as regional and global environment. Currently, a major proportion of energy is produced primarily by the use of fossil-fuels. These fuels are largely responsible for global warming and greenhouse effect, due to related massive emission of $CO_2$ and other greenhouse gases into the atmosphere. The existing methods of production are not sustainable and would not contribute towards long-term sustainable development.

Nowadays, everybody talks about "Sustainable Development" without understanding its real essence. Sustainability is a different entity to different people, and to different groups of people in different professions. It has been widely discussed and has been defined in many different ways. Over 140 definitions of sustainable development are now available in the literature. However, widely acceptable and most commonly used is the one provided in1987 by the Brundtland Commission or the World Commission on Environment and Development, as:

*"Development that meets the needs of the present, without compromising the ability of future generations to meet their own needs".*

Use of fossil-fuel as the only source of energy is not conducive to achieving sustainable development. The current major energy-sources, the fossil-fuels, with very limited

reserves, are environmentally harmful and are physically unsustainable. Our generation has to work together to find a solution to this problem. The international community, governments and society should collectively choose to change energy-use pattern, look for more sustainable sources, e.g., renewable energy and use alternate energy technologies.

## 3. ACCESS TO COMMERCIAL ENERGY IN RURAL AREAS

It is speculated that about 1.6 billion people around the world have no access to commercial sources of energy and depend on biomass energy (wood, dung, agricultural waste) to meet their cooking and heating needs. Out of these, some 700 millions live in India alone. A similar situation prevails in Pakistan, where 68 % of the population is living in rural areas, with 40% of the total living without electricity. There are many remote areas and far-flung places where extension from the national grid is not economically viable. Due to acute shortage of commercial energy, the country is facing severe economic crisis. Load- shedding has become a regular practice; in some areas the duration has reached to 16 hours a day. It has paralysed the national economy, with closure of industries and small business, leading to low productivity and increase in unemployment. The Government is struggling to overcome the energy shortages. New initiatives, like planning mega power projects and use of renewable energy for rural electrification are attempts to alleviate this huge shortfall in electricity sector. It is a well-recognised fact that unavailability of commercial energy is one of the main causes of poverty and of lack of progress in the rural areas. With our limited resources, it does not seem possible to supply fossil-fuel based electricity within a foreseeable period to every Pakistani and, in particular, to the rural population. Non-traditional productive activities, development of small and medium-sized industries, enterprises, increased agricultural productivity and public services are not possible without reliable electricity supply. Large fossil-fuel based power stations are capital-intensive. Even if the capital is available, the impending obstacles to deploy fossil-fuel power stations are:

- *Limited Fossil Reserves* – Exhaustible but cheap sources will bring to an end the era of fossil-fuel-driven industrialisation, within fifty to hundred years.
- *Adverse Environmental and Ecological Impacts* – Damaging the environment, the impacts of greenhouse gas emissions on the climate are already becoming evident.

Renewable systems would play a key role in overcoming these drawbacks. Table-2 shows the present status of the world's energy consumption, fossil-fuel reserves and the energy available on Earth from various sources [Goldemberg, 2004]. The table indicates that the reserves of fossil-fuels are limited, but renewable energy is aplenty, having abundant solar energy, which is available in an amount thousands of times more than the energy emitted by all the other types of renewable energy sources and is inexhaustible, as long as the sun shines.

The Government of Pakistan is striving to provide the common man with the basic

necessities of life, including water and electricity. It has developed a programme of electrifying 7,500 villages, mostly on the basis of decentralised power-supply systems based on renewable energy resources, including solar, wind and bio-diesel. The programme, if properly implemented, can contribute substantially to reduce poverty through development of small industries, creation of employment-opportunities and promotion of sustainable development.

**Table - 2: Energy Available on Earth**

| Energy Source | $x10^{12}$ watts |
|---|---|
| Present world energy consumption | 12.7 |
| Solar | 174,000 |
| Geothermal | 32 |
| Tidal | 3 |
| Photosynthesis | 40 |
| Winds, waves convection and currents | 370 |
| Fossil-fuel reserves (mainly coal) | ≈ 2000 |

## 4. RENEWABLE ENERGY OPTIONS

Renewable energy is the form of energy derived from natural processes that are constantly replenished. In its various forms, it is derived directly or indirectly from the Sun, or from heat generated deep within the Earth [IEA, 2003].

Escalating oil prices gave rise to concerns regarding the world's dependence on fossil-fuels as the main source of energy. Environment-related issues, such as climate change, are linked mainly with the combustion of fossil-fuels and have added further importance to the need for alternate and renewable forms of energy. In the wake of the recent energy- shortage, Pakistan should set its priorities, bringing to the forefront the harnessing of renewable forms of energy and dissemination of technologies that would increase the use of these sources.

Renewable energy sources are inexhaustible and abundant, as shown in Table-2. Unlike fossil-fuels, these can be replenished quickly and will not run out or be depleted. Modern sophisticated renewable energy systems are now available and can supply reliable and affordable electricity. Table-3 shows the present annual growth in some renewable energy systems. The PV system, with 43% annual growth, stands at the top of this list. The systems are environmentally friendly, clean and mostly emission-free. These are locally available and require no fuel-consumption, because natural resources are directly utilized to generate energy or electricity.

**Table - 3: Growth of Renewable Energy**

| Energy Source | World Annual Growth (%) |
|---|---|
| PV | 43 |
| Wind | 28 |
| Biomass | N/A |
| Geothermal | 3 |

## 5. RENEWABLE ENERGY INDUSTRY – EMPLOYMENT PROFILES

Lack of any official classification of the companies involved in renewable energy systems and component manufacturing makes it difficult to categorise employment opportunities in renewable energy sector. Table-4 summarizes the main profiles required by renewable-energy industries, according to the nature of their core business.

Renewable energy tends to be a more labour-intensive energy-source than the still-dominant fossil-fuels. A transition toward renewables thus promises job-creation. Currently, about 2.3 million people, worldwide, work in renewable energy industries, either directly or indirectly. About 300,000 people are employed in wind energy industry, some 170,000 in solar (PV) and at least 624,000 in solar-thermal industry. More than 1 million jobs are found in the biomass and biofuels sector [Renner, 2008]. A few countries have emerged as leaders in renewable energy development with strong government support. A study, commissioned by the German government, showed that in 2006 the country had some 259,000 direct and indirect jobs in the renewable energy sector [Renner, 2008]. Spain has also seen its renewable energy industry expanding rapidly in recent years. The industry now employs some 89,000 people directly (mostly in wind power and PV) and another 99,000 indirectly.

Denmark has long been a leader in wind energy development and employed about 21,000 people. In the United States, renewable energy sector employed almost 200,000 people directly in 2006 and another 246,000, indirectly. According to rough estimates, nearly a million people in China currently work in the renewable energy industry [Renner, 2008]. In Table-5, the number of people employed in wind industries in selected European countries are given [EWEA, 2009]. It can be observed that a significant proportion of the direct- employment in wind-energy is in three countries, Denmark, Germany and Spain. The combined installed capacity of these countries adds up to 70 per cent of the total in the EU from wind energy, and employs around 75 per cent. In Spain, direct employment number is now slightly over 20,500. When indirect jobs are taken into account, the figure goes up to 37,730. The details of employment in various sectors are as follows:

- Manufacturing Companies 30%;
- Installation, O&M and Repair Companies 34%;

**Table - 4: Typical Employment Profiles related to Renewable-Energy Sector**

| Industry/Company | Activity Field | Job Profiles |
|---|---|---|
| Manufacturing Companies, Component Providers | Producers of main components and sub-components. Factories and small industrial units assembling the components. | • Highly qualified chemical, electrical, mechanical & materials engineers, dealing with R&D issues, product design and production, management and quality-control of production process.<br>• Semi-skilled and non-skilled workers for the production chains.<br>• Environmental engineers and other specialists, to analyse the environmental impacts.<br>• Health and safety, experts, to ensure workers safety at work.<br>• Technical staff for the O&M and repair.<br>• Other supporting staff (including administrative, sales managers, marketing and accounting). |
| Developers, Builders and Installation Specialists | Manage all tasks related to the development and installation of energy- system. | • Project managers (engineers, economists) to coordinate the process.<br>• Engineers, for the coordination for construction works.<br>• Specialists in the transport of heavy goods.<br>• Technical staff specialised in installation.<br>• Semi-skilled and non-skilled workers for the construction process.<br>• Environmental engineers and other specialists to analyse the environmental impacts.<br>• Programmers and meteorologists for energy (e.g. solar and wind) |

*contd...*

*...contd*

| | | |
|---|---|---|
| | | forecasts and prediction models.<br>• Health and safety experts, to ensure workers' safety at work.<br>• Other supporting staff (including administrative and accounting). |
| Repair and O&M | Inspection and repair activities. | • Technical staff for the O&M and repairing.<br>• Health and safety experts, to ensure workers' safety at work.<br>• Other supporting staff. |
| Energy Promoters, Utilities selling electricity | Operation and sale of the electricity produced. | • Marketing and sale personnel, to deal with the sale of electricity.<br>• Event organizers<br>• Experts in social surveys, training and communication.<br>• Other supporting staff (including administrative and accounting). |
| Consultants, legal firms, financial institutions, insurance companies, R&D centres. | Diverse specialised activities linked to the renewable energy business. | • Programmers and meteorologists for the analysis of resources, like wind and solar potential and output forecasts.<br>• Engineers specialised in specific areas and other R&D.<br>• Environmental engineers.<br>• Energy-policy experts.<br>• Financiers and economists.<br>• Lawyers specialised in energy and environmental matters. |

- Promotion and Engineering Companies 27%; and
- Other Branches 9%.

The direct employment according to EWEA Survey, by type of company, is displayed in Figure-1 (EWEA, 2008). As observed from the figure, about 60% of the employment opportunities are offered by manufacturing industries.

According to the statistics provided by Eurostat, the energy sector employs 2.69 million people, accounting for 1.4% of total EU employment. Wind energy currently meets 3.7% of EU electricity demand and employs around 7.3% of the total. There is a well-documented trend of decline of employment in the energy sector of Europe,

**Table - 5: Direct Employment in Wind Energy Companies in Selected European Countries**

| Country | No. of Direct Jobs |
|---|---|
| Austria | 700 |
| Belgium | 2,000 |
| Bulgaria | 100 |
| Czech Republic | 100 |
| Denmark | 23,500 |
| Finland | 800 |
| France | 7,000 |
| Germany | 38,000 |
| Greece | 1,800 |
| Hungary | 100 |
| Ireland | 1,500 |
| Italy | 2,500 |
| The Netherlands | 2,000 |
| Poland | 800 |
| Portugal | 800 |
| Spain | 20,500 |
| Sweden | 2,000 |
| The United Kingdom | 4,000 |
| Rest of E.U. | 400 |
| **TOTAL** | **108,600** |

**Source:** *EWEA (2008)*

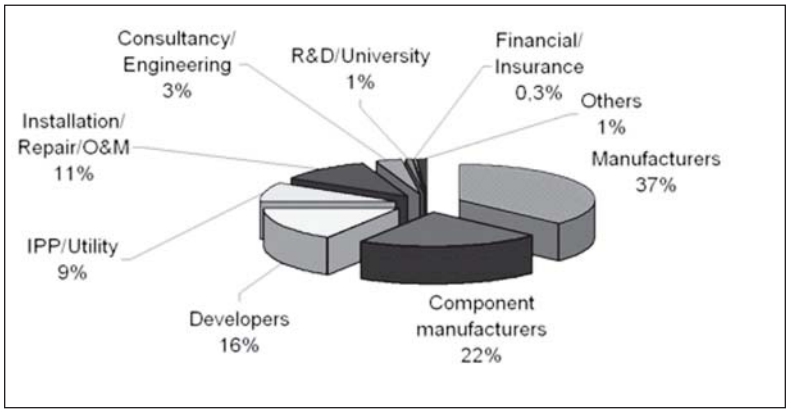


**Figure - 1: Direct Employment by Type of Company**

particularly in the coal sector. For instance, British coal production and employment in the sector have dropped significantly, from 229,000 workers in 1981 to 5,500 in

2006. In EU countries, more than 150,000 utility and gas industry jobs disappeared in the second half of the 1990s and it is estimated that another 200,000 jobs will be lost during the first half of the 21st century. These job losses in the European energy sector are independent of renewable energy deployment. The employment statistics in renewable energy sector are, in fact, helping to mitigate these negative effects in the power sector.

In many countries, the future employment trend as well as rapid growth in renewable energy industries and related service sectors, indicate the potential of renewable energy technologies to offer great employment opportunities. The development and deployment of renewable-energy technologies require both skilled and unskilled work-forces and are thus important for local employment and income-generation. Usually, renewable energy devices are decentralized, modular in size and involve short construction-times. Table-6 provides an idea of the number of jobs per unit of energy generated from different sources [Goldemberg, 2004].

**Table - 6: Direct Jobs in Energy Production from Various Sources**

| Energy Sector | Jobs - year / Terawatt-hour (Fuel Production & Power generation) |
|---|---|
| Petroleum | 260 |
| Offshore oil | 265 |
| Natural gas | 250 |
| Coal | 370 |
| Nuclear | 75 |
| Wood energy | 733 - 1067 |
| Hydro | 250 |
| Minihydro | 120 |
| Wind | 918 - 2,400 |
| Photovoltaics | 29,580 - 107,000 |
| Bioenergy (from sugarcane) | 3,711 - 5,392 |

**Source:** *Goldemberg, 2004*

## 6. ENERGY SITUATION IN PAKISTAN

Despite enormous potential of its natural and human resources, Pakistan remains energy-deficient. The country relies heavily on imports to meet its ever-increasing demand of energy. Energy is extracted from a variety of traditional and commercial sources. The total primary energy consumption in Pakistan, given in Table-7, is

**Table - 7: Primary Energy Supplies in Pakistan, break down by Source (1998–99)**

| Commercial Energy Sources | Primary Energy Supplies (%) |
|---|---|
| Oil | 42.80 |
| Gas | 38.61 |
| Coal | 5.20 |
| Hydro | 13.00 |
| Nuclear | 0.20 |

currently estimated at around 60 million tonnes of oil equivalent [Szweda, 2003]. The primary commercial consumption of 41.7 million tonnes of oil equivalent is largely based on the use of fossil fuels.

## 7. RENEWABLE ENERGY DEVELOPMENT IN PAKISTAN

Favourable geographical location makes Pakistan ideal for harnessing of unlimited solar energy. During the last three decades, Pakistan has begun to develop its potential in renewable energy. Pakistan Council for Renewable Energy Technology (PCRET), (previously known as National Institute of Silicon Technology – NIST) and Alternative Energy Development Board (AEDB), established under the Ministry of Science & Technology, Government of Pakistan, are aimed at promoting and facilitating the exploitation of renewable energy resources in Pakistan, so as to achieve the GoP's renewable energy deployment targets. PCRET has been engaged in fabricating solar cells, modules and systems, but very little has been reported about production-capacity or cell-efficiency. The PV technology is particularly suitable for small power-requirements and remote-area applications. In early 1980s, eighteen PV stations in different parts of the country were set up for village electrification, with a total installed capacity of nearly 440 kW [Szweda, 2003].

Currently, solar technology is being used in Pakistan for rural telephone-exchanges, repeater stations, highway emergency telephones, cathodic protection of pipelines, refrigeration for vaccine and medicines, etc. Solar water-pumping units have also been installed in different parts of the country. Both the private and public sectors are playing important roles in the popularization and upgrading of PV activities across the country. A number of companies are not only involved in trading PV products and appliances, but also in manufacturing various components of PV systems. They are selling PV modules, batteries, regulators and invertors, as well as practical low-power devices for load-shedding, such as photovoltaic lamps, battery chargers, garden lights, etc.

Pakistan has a great potential for renewable energy, but its market penetration is slow, as compared to many other developing countries (even less than India and Bangladesh). The current status of renewable energy in the country and the available resources is given in Table-8.

**Table - 8: Potential and Status of Renewable Energy in Pakistan**

| Resource | Potential | Status (2006) |
|---|---|---|
| Hydro | Conservative estimate is 45,000 MW, including all sizes of hydropower plants. | • Large >250MW 5,928 MW<br>• Medium 437 MW of medium (>50 MW and <250 MW),<br>• Small to micro < 50 MW, 253 MW<br>• Exploited 6,608 MW of total capacity, <15% of the total identified potential. |
| Wind | Commercially exploitable resources exist in many parts, especially in southern Sindh and coastal Balochistan, with monthly average wind speeds exceeding 7-8 m/s | • No commercial wind farms in operation.<br>• Micro-wind turbines pilot tested for community use. |
| Solar Photovoltaic (PV) and thermal | Potential Areas Balochistan, Sindh, and southern Punjab, receiving solar irradiation on the order of over 2 MWh/$m^2$ and 3,000 hours of sunshine a year, at the highest end of global insolation averages. | • Negligible use in niche applications.<br>• No significant marketing of rooftop PV or household & commercial thermal systems. |
| Biomass | Pakistan's large agricultural and livestock sector produces copious amounts of biomass in the form of crop residues and animal waste, such as bagasse, rice husk, and dung.<br>Municipal solid waste can also contribute. | • Sugar mills in the country use bagasse for cogeneration purposes and have recently been allowed to sell surplus power to the grid up to a combined limit of 700 MW. |

## 8. SUGGESTIONS: RENEWABLE ENERGY PROGRAMME

It has now been proven worldwide that the renewable energy technologies offer tremendous employment-opportunities, apart from meeting the energy requirements of rural areas. Deploying renewable systems, however, requires addressing various issues related to technology diffusion. Some suggestions are given to expedite the deployment of renewable energy in the country.

- To launch an intensive undergraduate and research degree programmes for producing experts and scientists in renewable energy technology areas;
- To initiate certificate and diploma programmes for training of technicians in specific areas of renewable energy;
- To enhance the awareness of renewable-energy applications among various stakeholders, industrialists, entrepreneurs, policy-makers and the general public;

- To encourage and facilitate entrepreneurs to develop trade and investment relations with partners in other parts of the world, particularly with the countries operating well- established programmes, Australia, Canada, Europe, Japan, US and Scandinavia;
- To initiate small and large demonstration projects in rural areas, contributing towards development and poverty reduction;
- To devise policies for ensuring the mitigation of environmental impacts associated with the use of fossil and non-sustainable fuel supplies.

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# SOLAR-THERMAL ENERGY UTILIZATION: THE MOST COST-EFFECTIVE AND THE BEST EMPLOYMENT-GENERATING ENERGY SOLUTION FOR THIRD-WORLD COUNTRIES

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**ABSTRACT**

*After discussing the technological aspects of solar-thermal energy utilization for large-scale power generation and a review of work done at CIIT, a cost-benefit analysis of solar-thermal energy is presented in this paper. It has been argued that completely indigenous solutions are possible with this technology, making it completely sustainable for a third-world country. It has been concluded that, apart from solving the energy problem (for once and for all) in the non-OPEC countries, a large quantum of employment-generation can result from utilization of solar- thermal energy.*

## 1. INTRODUCTION

Most of the third-world countries lie on the high insolation solar belt of the planet, resulting in a highly advantageous situation for the use of solar energy. It is unfortunate that the planners of the developing countries look towards those countries for their energy-solutions, which themselves are not very lucky as far as this gift of nature is concerned. solar-thermal energy for space and water heating is a simple affair. One only has to have a flat-plate absorber, with good insulation on the back, and a glass top above. However, for power-production, higher temperatures are required.

## 2. SOLAR-THERMAL ENERGY FOR POWER GENERATION: THE NEED FOR SOLAR CONCENTRATORS

Steam turbines require high-pressure steam for the generation of electricity and hence high-intensity solar radiation is needed. There are various types of solar concentrators, which include parabolic dishes, cylindrical parabolic troughs, multiple flat-mirror arrangements and Fresnel mirror arrangements. A lot of attention has been shifted to Fresnel mirror concentrators in the last few years. From the Third World's point of view, this is the most practicable technology. The main components of this arrangement are flat mirror-strips arranged and oriented in such a way that a large number of these strips reflect the solar radiation onto a single pipe, in which the fluid

to be heated is running. Depending on the number of mirror-strips, a multiple of the Sun's intensity is incident on the pipe (See Figure-1). There is no upper limit of temperature that can be attained by this arrangement. Even high-pressure steam can be directly obtained from this arrangement, provided the tube is strong enough to stand the pressure. The temperature attained in this system depends only on the rate of flow of fluid through the pipe. Figure-1 shows the essential set- up of Fresnel-mirror arrangement. The strips are arranged in a frame placed on the flat ground in east-to west direction. Each strip is oriented in such a way that it reflects the Sun's rays directly on a tube held parallel to all the mirror strips. As the Sun moves from east to

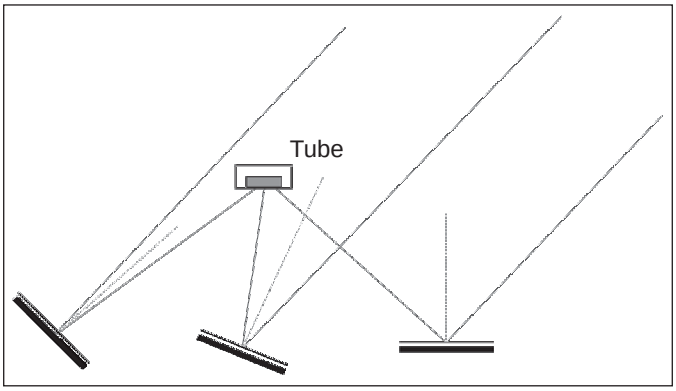


**Figure-1: A Sectional View of Fresnel Mirror Arrangement**

west, the concentrated reflected radiation only moves along the length of the tube, always remaining focused on it. Any motion of the Sun in the north-south direction through an angle $\sigma$ will require all the mirrors to rotate independently, but at the same time, through an angle $\sigma/2$. Hence once these strips are arranged, one has to keep on changing the angles of all the mirrors simultaneously alongwith the change in north-south position of the Sun. All this can be done by a properly programmed electronic controller (microprocessor).

It may be noted that the north-south position of the Sun does not only change by about 34° from 22 June to 21 December (in Islamabad), but it also changes by a few degrees from morning to noon and back (in the evening). This daily variation is highest in the winter and lowest in summer. All this system can be completely indigenized, as cutting of flat glass strips and framing them does not need any complicated technology. The control system needs some software, for which the programming expertise is locally available. The fluid heated by the solar concentrators can itself be high-pressure steam or some high boiling-point oil, which can then exchange heat with water to generate high-pressure steam. This high-pressure steam can then, in turn, drive a steam turbine connected to a night storage of heat electricity generator (The author has taught this subject to thousands of students in Peshawar and Islamabad).

The oil heated in this system can also be stored in insulated tanks for use during the night. Storage of solar thermal energy is a tricky business. For space-heating, where temperatures in the vicinity of room temperatures are to be maintained, certain salt mixtures are used, which freeze at a certain temperature giving out their latent heat of fusion as heat energy. However, for higher temperatures, different oil reservoirs can be used to store heat. This needs some investigation. For steam generation considering the latent heat of steam to be 540 cal/gm at 100°C and considering that the specific heat of most oils is well below 1, i.e. well below that of water, it can be concluded that about 500gm of oil will lose 1°C of temperature to boil 1 gm of water. Quite interesting calculations can be performed on the basis of the facts given above. One such calculation shows that to boil 1 metric ton of water at 100°C, the temperature of four metric tons of oil is to be decreased by 135 Kelvin. This is reasonable if the initial temperature of oil is well above 235°C, which can be easily managed within the boiling points (~500°C) of most oils. It can be concluded that heat-energy stored in a few metric tons of oil can generate enough steam to run a steam-turbine generator for sufficient hours after the sunset. The amount of oil for the heat reservoir can of course be calculated, on the basis of load and the conversion-efficiency of the generator. The cost of thermally insulated oil-containers as well as the cost of used engine-oil is a "one-time" expense, making the whole system quite cost-effective, as compared to electric storage batteries.

### 2.1 Molten Salt Storage

A variety of fluids have been tested to transport the Sun's heat, including water, air, oil, and sodium, but molten salt has been found to be the best choice. Molten salt is used in solar- power tower systems because it is liquid at atmosphere pressure; it provides an efficient, low-cost medium, in which to store thermal energy. Its operating temperatures are compatible with today's high-pressure and high-temperature steam-turbines and it is non-flammable and nontoxic. In addition, molten salt is used in the chemical and metal industries as a heat-transport fluid, so experience with molten-salt systems exists in non-solar settings.

The molten salt is a mixture of 60 percent sodium nitrate and 40 percent potassium nitrate, commonly called "saltpeter". The salt melts at 220°C and is kept liquid at 290°C in an insulated storage tank. The uniqueness of this (solar) system is in de-coupling the collection of solar energy from producing power; electricity can be generated in periods of inclement weather or even at night using the thermal energy stored in the hot salt tank. Normally, tanks are well insulated and can store energy for up to a week.

### 2.2 Steam Turbine

As against common understanding, steam turbine is not a very complicated technology and a steam turbine industry can be easily developed in a third-world country. The main principle of these turbines is the energy transfer between high-velocity water-molecules (steam) and the turbine rotor. The impulse and reaction

turbines are the two major types of turbines that are employed in energy-conversion from heat energy to electrical energy.

### 2.3 High-Efficiency Turbine

The efficiency of a steam turbine depends on the temperature of steam, which is limited by the boiling point of storage media. Using molten-salt storage arrangements, the steam temperature can be raised to 1,000°C, thus resulting in another 30 to 40% rise in turbine- efficiency, taking it to more than 60 %.

### 2.4 Tesla Turbine

The Tesla turbine can play a very important role for any indigenous development of renewable energy in a third- world country. Due to its small size and simple construction, Tesla turbines are most suitable for domestic solar-electricity generation (Figure-2). A 2 KW Tesla-turbine generator can run for 24 hours, using storage source at night.

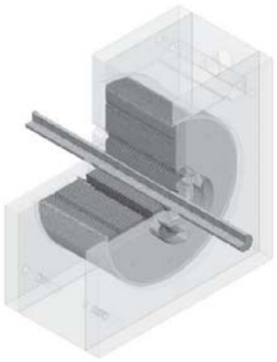

**Figure - 2: Tesla Turbine**

## 3. A COST-BENEFIT ANALYSIS OF SOLAR-THERMAL ENERGY UTILIZATION

A 4 KW peak input power-system is being developed at CIIT Islamabad. Fresnel mirror arrangements of 1 $m^2$ each, with 40 mirror strips are underway (Figure-3). A microprocessor base electronic control-system is being developed to track the Sun for it. The receiver is a 20 ft long, 1/2" x 3/2" duct surrounded by glass wool and steel jacket on three sides. An impulse steam-turbine, with a rotor diameter of 10", is also being developed. Used engine oil will be allowed to circulate through the steel duct to absorb heat from solar concentrators, while being stored in an insulated reservoir. Steam will be generated from a boiler (pressure cooker) immersed in the hot oil. At an oil temperature of 400°C, we can expect a turbine-efficiency of 25% and a total efficiency between 10 and 20%.


**Figure - 3: Fresnel Mirror Concentrator being investigated in R&D Lab at CIIT (The camera is right above the object)**

The total cost of the above-mentioned system is estimated to be Rs. 40,000. Considering the worst case scenario, i.e. a 10 % efficiency, the output of this system would be 400 watts, which gives an overall cost of Rs.100 (or $1.25) per watt. This is far less expensive than $2.75 per watt for setting up a photovoltaic system of the same capacity.

## 4. LOCAL TURBINE INDUSTRY

If we are going to extract solar thermal energy from our roof-tops, a local small-turbine industry will also have to grow. For this purpose, initially, research and development programmes on the design of small and large steam-turbines are necessary. Researchers at R&D lab of CIIT are presently working on a small impulse-turbine for the domestic electricity production. However, scarcity of funds is hindering our progress.

## 5. ADVANTAGES OF SOLAR-THERMAL ENERGY SYSTEM

### 5.1 Cheaper Storage

Heat storage is much cheaper and sustainable, compared with electrical charge storage. An insulating tank filled with oil has a much longer life than batteries. Molten-salt storage for higher-temperature storage is also being investigated, thus making the turbine-efficiency much higher.

**Figure - 4: A Fresnel Concentrator in Spain**

### 5.2 Easy to Disseminate Knowledge

The solar-thermal technology is almost a matter of common sense, and consists of:

- A flat mirror assembly, focusing the Sun's rays to a parallel linear absorber,
- Heat-transfer from hot oil to water, for the generation of high-pressure steam, and
- Running a steam-turbine, coupled with an electricity generator.

An energy-solution with a big job market potential all in all, using Fresnel's mirror arrangement to generate electricity, is a totally indigenous activity, which can generate a large job-market along with bringing about a sustainable energy solution. The capital cost of this arrangement, being about one dollar per watt, is much cheaper than that of photovoltaic converters, the capital cost of which is nearly 3 dollars per watt.

**Figure - 5: A Fresnel Concentrator in Australia**

In a nutshell,

i. *Solar thermal energy* is low cost;
ii. More efficient;
iii. Involves no foreign exchange;
iv. Can create a big job-market; and
v. Rejected steam can do other jobs, such as space heating, space cooling, etc.

### 5.3 Solar-Thermal versus Photovoltaic

It must be kept in mind that PV panels or PV cells are not only imported against valuable foreign exchange, but are also prohibitively expensive. Our study has shown that the payback period of a PV system is almost double the life span of the system itself. On the other hand, a solar-thermal energy system can not only be completely indigenous, but is also far less expensive. One of the main advantages of it being indigenous is its ability to generate a big job-market.

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# HOUSEHOLD WIND-ELECTRICITY GENERATING UNITS FOR EMPLOYMENT GENERATION

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**ABSTRACT**

*Pakistan's energy resources comprise nuclear, petroleum, gas, coal, water, solar, forests and wind. Its current energy-mix is highly dependent on oil, liquid petroleum gas (LPG) and natural gas that together account for 85.2% of the total primary energy supplies of 44.465 million tons of oil equivalent (MTOE). Coal contributes only 4.5% to the total supplies, while nuclear energy has a share of 1.1% and the remaining 9.2% is supplied by hydro-electricity. Pakistan has a considerable potential for production through wind energy in the coastal belt of its provinces Sindh and Balochistan and in the desert areas of Punjab and Sindh. This renewable source of energy has so far not been utilized significantly.*

*The collected data shows that the coastal belt of Pakistan is blessed with a God gifted wind corridor that is 60km wide (Gharo~Kati Bandar) and 180 km long (upto Hyderabad). This corridor has the exploitable potential of 50,000 MW of electricity generation through wind energy. It is estimated that more than 5,000 villages can be electrified through wind energy in Sindh, Balochistan and the Northern Areas. Wind-based electricity generation is not only cheap but does not require great ideas of assistance in developing and producing it. Once the technology is introduced to the manufacturers and vendors, it is expected to generate over 200,000 job opportunities for semi-skilled workers in Pakistan.*

## 1. INTRODUCTION

Pakistan is facing shortage of electricity while the demand is further growing (See Box-1). Apparently, the current shortage is the result of a number of factors, including low-capacity added during the last eight years, line losses, line theft, distribution mismanagement, etc. The actual demand is much higher, in view of the fact that 35 percent of the villages are still without electricity Pakistan's energy sources include, nuclear, petroleum, gas, coal, water, solar, forests and wind. Its present energy-mix is highly dependent on oil, liquid petroleum gas (LPG) and natural gas that account for 85.2% of the total primary energy supplies of 44.465 million tons of oil equivalent (MTOE). Coal contributes only 4.5% of the total supplies, while nuclear energy has a share of 1.1% and the remaining 9.2% is supplied by hydro-electricity.

**Box - 1: Power Demand**

According to a study, the provincial power demands in Pakistan are:

*Punjab:* The current power-demand in Punjab is about 7,027 MW, which is expected to rise to 24,000 MW in 2024-25 and 63,000 MW in 2030 at growth rate of 10.0%.

*Sindh:* The current power-demand of 2,642 MW in Sindh is expected to rise to 10,993 MW in 2024-25.

*NWFP:* The current power demand of 1,697 MW in NWFP is expected to rise to 7,018 MW in 2024-25.

*Balochistan:* In Balochistan, the current power demand of 474 MW is expected to rise to 1,964 MW in 2024-25.

Pakistan has a considerable potential of wind energy in the coastal belt of Sindh and Balochistan, as well as in the desert areas of Punjab and Sindh. This renewable source of energy however has not been utilized significantly so far. As per the collected data, the coastal belt of Pakistan is blessed with a God-gifted wind-corridor that is 60 km wide [Gharo to Kati Bandar) and 180 km long (upto Hyderabad)]. This corridor has an exploitable Potential of 50,000 MW of electricity-generation through wind energy. It is estimated that more than 5,000 villages can be readily electrified through wind-energy in Sindh, Balochistan and Northern Areas of Pakistan.

The cost of developing thermal electricity generation is high; it is also loaded with high transmission cost, through installation of poles and high-voltage cables. Development of dams is highly time-consuming and their capacity for generation of electricity average, five hundred megawatt. It takes something like eight years to construct a dam. In view of such difficulties, alternative sources are not only important, but are the need of the hour. Amongst other sources, wind is one source that is available in abundance and has not been much utilized. There is a need to develop indigenous technology, technical know-how and the infrastructure to promote it.

Hydel energy is cheaper per unit, but it takes a long time to establish and the cost of developing dams is very high with a limitation of inability to be produced in parts; i.e. until the whole dam is constructed, electricity cannot be generated. Hydel is also restricted to natural sites, long transmission wires are needed to transmit electricity through grid systems. Wind electric generation, on the other hand, can be done in pieces, investing more as it goes along the way. It is indeed restricted to the area where wind is available, however, as compared to hydel, its availability is more wide-spread

near villages, cities and industrial zones. Wind electricity can be provided to villages, without getting on the grid with high cost of transmission[†].

Wind electric generation is relatively costly if the technology is imported, but If domestic technology is developed, the wind-turbine system can be most economical and effective in providing electricity to remote villages and cities. It can be highly useful in developing industry based on electricity in remote areas, thus reducing the pressure on the urbanization.

Wind electricity generation requires a continuous wind of 8 miles per hour and higher. According to the mapping of the wind-data, a major part of Sindh and Punjab and the water-front from Thatta to Gawadar carry such high continuous wind[#].

Wind electricity generation can be carried out through various sizes of wind turbines. Large fans with diameter of over 150 meters are most efficient in delivering electricity. Such a fan generates as much as one to five megawatts of electricity, depending on the speed of wind. However, smaller fans also generate electricity but with less efficiency. A two-meter diameter fan can produce one kilo-watt and is ideal for one household. Where developing bigger fan involves higher technology, experience and know how, a small fan can be more easily produced by fan industry of Pakistan. This paper, therefore, concentrates on smaller fans that can be more easily produced locally, at relatively lower cost*.

## 2. TECHNOLOGY ADOPTION AND EMPLOYMENT

It is estimated that there is a demand of 80,000 household-level wind-generators in the provinces of Sindh and Balochistan alone, which are ideal for wind electricity generation. Production of these fans will generate around 200,000 regular jobs for fan makers. These initial estimates are based on not only the households but also small businesses suffering due to frequent load-shedding. A further expansion is expected when foreign market is explored.

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† In 2006, wind machines in the United States generated a total of 26.6 billion kWh per year of electricity, enough to serve more than 2.4 million households. This is enough electricity to power a city larger than Los Angeles, but it is only a small fraction of the nation's total electricity production, about 0.4 percent. The amount of electricity generated from wind has been growing fast in recent years. In 2006, electricity generated from wind was 2 ½ times more than wind generation in 2002.

# As a rule, wind speed increases with altitude and over open areas with no windbreaks. Good sites for wind plants are the tops of smooth, rounded hills, open plains or shorelines, and mountain gaps that produce wind funneling.

* We just featured the largest wind turbine in the world, now here's something at the opposite end of the spectrum: a household wind turbine. In the last few years, we've seen a lot of mini-wind turbines that haven't turned out to be very useful. But the Windspire turbine from Mariah Power sounds interesting. The Windspire has a propeller-free vertical-axis design, and is expected to produce about 1800 kilowatt hours per year in 11 mph average wind conditions. That amount of wind power is roughly 25% of a typical household's energy (or much more if you are particularly energy efficient). The Windspire is 30 feet tall with a two foot radius, sized below typical residential zoning restrictions. Guidelines for installation sites are generally half an acre of land and relatively windy locations. The Winspire has just passed the ETL safety certification, which means it's ready to go to market. It is expected to be released this spring, and priced at $3,995.

The wind electricity generation units require fan-blades, generator, converter to AC, gearing system to increase generator RPM and pole to install equipment. All these items are produced and used in different industries of Pakistan. The shift in technology and know how is the biggest barrier towards making wind-turbines. There is a need to develop a strategy to cope with this problem.

Although a few private companies have started working towards developing household level wind-turbines, the industry needs to be developed with a sufficient number of workers and entrepreneurs in the field so as to develop economies of scale and broader knowledge-base for efficient production. This problem of technology adoption can be arranged in the following ways.

## 3. STEPS TO ADOPT TECHNOLOGY

### 3.1 Organizing Training Programmes

A group of engineers and economists should be consulted to prepare training modules for a conference on wind-electric generating units. The organizers of this seminar should organize these trainings, with the following focus:

- Technical facilities for fan-industry owners and technical workers;
- Training for all those who are interested in venturing into wind-electric generation;
- Participants should be given both technical, as well as practical trainings, with the help of engineers, to actually design and develop wind-turbines;
- Teachers at engineering universities should also be given a fast-track refresher course to enable them guide the industry;
- Teachers at polytechnic colleges should be given a compulsory training;
- The organizers of this seminar should arrange to pay daily subsistence allowance to all the participants who would leave their jobs for the training;
- If possible the training should be arranged in Gujranwala and Gujrat for better participation of the relevant people, however, it can be arranged in Islamabad too;
- The organizers of this seminar, with collaboration from government, should provide each teacher of engineering and polytechnic colleges with a financial assistance of upto Rs. 100,000 to develop one such fan in their respective colleges, or in suitable locations, as demonstration units.

### 3.2 Marketing Efforts

Understanding the importance of household-level wind turbine in meeting the excess demand of electricity, government should take up marketing and advertising costs through its public and private sector media sources. A repeated advertisement will encourage the households to buy such equipment and create demand most necessary for the successful development of wind-turbines.

### 3.3 Encouragement from Government

Government should also plan to buy these wind-turbines for their local offices, community centres, street lights and other public usage so as to encourage development of this technology.

## 4. EXPECTED OUTCOME

By creating know-how of wind-electric generation, a number of investors will venture into the industry, foreseeing the existing electric shortage and the high price of electricity. This will create enormous number of jobs at the skilled and semi-skilled levels. The expected job creation will be around twenty thousand in number.

It is expected that, by venturing into development of wind turbines, many of the remote villages that never had the chance to get electricity will be able to use electricity, television, mobile phones, and other house hold appliances. The impact of these items will expand the market further and will create jobs in the area of sales and repair.

Transfer of technology will find some of its own benefits, e.g. the development of wind water-pumps, wind flour-mills, wind small industry. The direct effect on pollution will be enormous. Wind-turbine does not create any sort of pollution what so ever. The exercise, besides other things, will create confidence amongst businesses and industries that local technology can work and would be adopted. The approach to depend on indigenous resources and technology is the key to success for most of the developing and developed countries.

## 5. CONCLUSION

Wind energy generation is not new to the world. Historically windmills, wind water-pumps, wind manufacturing units, wind cranes and wind electricity-generators are being used for ages. However, cheaper availability of petrol, diesel and furnace oil during the twentieth century had reduced the attraction of these sources of energy. A recent increase in oil prices in the world has once again forced the decision and policy-makers to look into other areas of energy-generation. Wind electric generation is extremely useful in areas where continuous high-wind exists and is remote in nature. For a small village, where population is low and for which transmission lines are expensive, wind energy could be highly economical in use. Economy-planners who focus on optimal utilization of resources prefer wind-generators over other sources of energy.

Small wind-generators are extremely important for many reasons; the most important of all being its support in development of indigenous technology for bigger and more efficient wind-turbines. It is expected that such turbines will soon be very popular sale-items around Africa and Asia.

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# WIND-ENERGY APPLICATIONS AND SOCIAL UPLIFT OF LOCAL POPULATION

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**ABSTRACT**

*The paper describes application of wind energy at two levels of domestic applications and grid-connected megawatt class turbines. Domestic applications cover power- generating micro-turbines as well as water pumping units. Similarly, the megawatt class turbines are discussed with wind-farming concept. In each case the commercial activity generation and benefit to local population is highlighted. Wind energy and work-opportunities that are being created or will be created by this potentially expanding field of energy are discussed in this paper. Typical success-stories from induction of micro turbines in the Karachi coastal region are related. The immediate and long-term benefits accrued to the localities are also brought out.*

*Similarly, rising interest of urban population in domestic wind turbines in the backdrop of load-shedding is discussed. This has generated good commercial activity and is likely to grow in the coming years. A brief overview of the industrial activity generated by this new technology is also covered. In conclusion, recommendations have been made for smooth induction of this relatively new and novel technology in Pakistan. Onus of social acceptability lies on the private investors who are urged to include the local populace in reaping the benefits.*

## 1. INTRODUCTION

Wind power is new to Pakistan. Nevertheless, all of us need to understand this novel, yet otherwise not so new, technology. The way it may affect our lives or lives of those involved with this field is dawning, as the technology is spreading.

In the alternative energy field, work is being done in many areas, such as solar, bio-diesel, waste to energy, but the wind-energy sector seems to be very promising due to the natural wind-corridor existing on the Arabian Sea coast on the Sindh-Balochistan coastal areas. Pakistan Meteorological Department (PMD) has carried out extensive surveys to record wind-data, using automatic data-loggers on 44 masts erected in the wind-corridor. Based on their study, PMD has classified the available wind regime as 'Excellent' (Table-1).

**Table - 1: Classification of Winds in Pakistan**

| Class | Wind Speed (m/s) | |
|---|---|---|
| Fair | 6.2 - 6.9 | ← Majority |
| Good | 7.0 - 7.3 | ← Few |
| Excellent | 7.4 - 7.8 | Sindh Corridor 7.5 - 7.7 m/s |
| Outstanding | 7.9 - 8.5 | |

The proof of good winds is already there in the form of almost one thousand megawatts of wind-energy being produced by India in Gujrat area, since Gujrat is the tail end of the same wind-corridor originating from the Arabian Sea.

The environmental impact of wind power on local population, on the animal and, especially, bird population, the flaura, fauna and ecology of the area where wind-turbines are installed, is pretty well understood now. An excellent project has recently been completed by UNDP covering this subject and is available to all stakeholders.

It is of interest to see how the onset of wind-technology has started affecting Pakistan's population. And this phenomenon is worldwide. Every country, where wind-power has grown, has to deal with this social aspect in its own way, depending on the cultural and social set up of the population. The first reaction of the local population anywhere in the world, including Pakistan, has been apprehension. At public hearing of wind-farm projects at the site of Zorlu Enerjie in Jhimpir area, a group of local population gate-crashed into the proceeding arena and demanded an end to the use of "their" winds, or some compensation be given to them. The mayhem created was intelligently controlled by the honourable Minister of Environment, by promising to visit them separately and redressing their grievances.

In July 2009, during the 8$^{th}$ World Wind-Energy Conference in South Korea, a Canadian wind-energy expert quoted his experience with the local populace when he first approached them for renting space to erect the wind turbines. They would not accept this new technology, at any cost, and would keep showing their apprehensions regarding their personal and family well-being, as well as that of their livestock and farmlands.

Not until he was able to workout a method of having them invest in the wind-power project and thus guarantee them regular income in the next 20-25 years, could he get cooperation from them. That was Canada, where money is the king. Not so in our country, where more than money, social amenities are in demand. This phenomenon is universal and we must carefully handle it, so that the benefits are enjoyed by everyone according to their share.

As for the social impact, especially the positive influence of wind technology on the local population, both in deriving benefit and in getting commercial gains, it is better

to take into account the following:

- Small, kilowatt-class turbines, employed in rural and urban applications; and
- Large megawatt-class turbines for grid connection.

## 2. COASTAL AREA APPLICATION

- Karachi has a large coast, where grid-electricity is yet to be provided. During a survey along the Hub sea coast, where wind is in abundance and the grid does not exist, some very interesting applications were found. A few examples are quoted here: Pakistan Council for Renewable Energy Technologies (PCRET), established by the Federal Govt., installed a 5 KW used wind-turbine on the Hub coast. They also made arrangements for charging batteries by this wind turbine. Neighbouring villagers started using batteries to light a bulb or two in their humble one-room dwellings, thus extending their days by two to three hours. They could now get their batteries charged, every ten days or so, from this wind turbine for as little as Rs. 20. The technician at this wind-battery-charging station confirmed that he had been providing service to eighteen villages of the surrounding areas. The good thing about this application is that the local population had started participating voluntarily. Commercial interest has ushered small-scale business for providing batteries, DC bulbs, etc., with young lads getting hands-on experience in electrical wiring technology.

- In another similar success story, the Headmaster of a primary school in a fishing village, by the name of Mubarik Village, with no grid supply got a wind-turbine installed at his school through the good offices of the German consulate in Karachi. When asked what use it was for him, as he was running a day school, he explained that for one, he could now teach computer basics to his students. In other words with electricity now available, he could provide computer hands-on training/experience to his students. Secondly, and more importantly, according to him, appropriate time for fishing was early morning and day time. As such, many of the fishermen took their school-going sons to help in fishing during the day. As such, they were missing on school. However, now he could run an evening shift for these young lads. The wind turbine thus saved many boys from illiteracy. It also might produce computer wizards of tomorrow.

- Allah Bano Village, a small coastal village, had at least two wind-turbines rising over the hutments and providing sufficient electricity to light up the homes of not only the owners but also a couple of neighbours. Once again, commercial activity has been generated to the benefit of the population.

- The most popular, of course, was the water-pumping turbine. Dozens of them form the sky line, in and around Mubarik Village, Ali Bux Village, and even the Hub coastal region. This last one was very interesting as it resulted in growing two varieties of coconut and a local fruit called 'Chikoo' on the soil with brackish water.

## 3. MICRO RURAL APPLICATION

AEDB identified certain villages of Sindh, where the public utility was unable to provide power, due to distance from the grid. Several such villages were provided with about one hundred stand-alone micro-turbines in order to provide basic minimum power to the residents. One turbine could extend power to several hutments. This experience, however, did not prove very successful as the local population was not ready to accept this new technology. During survey visits, several of these turbines were not found to be working. The one in the local mosque, however, was fully functional since someone had direct interest in it.

Similarly, in areas where wind velocities were good, the water pumping wind turbines have also been introduced.

## 4. URBAN AREA USAGE

Karachi being a port city enjoys good winds throughout most part of the year; the land and sea breeze phenomenon results in reasonably high-velocity winds during the day and night, respectively. Fed up of the "load shedding" by KESC, many residents of Karachi have resorted on using the micro wind-turbines of one to two kilo watts on their roof-tops to cater to their basic needs. Wind turbines offer noiseless power when needed, without the hassles of a petrol or diesel generator. Commercial firms sprang up, offering both stand-alone turbines and hybrid solutions, combining solar panels to wind turbines for the windless days. A lot of business activity has been generated by this application.

## 5. DOWNSTREAM INDUSTRY

As a result of the wind-turbine usage, commercial activity has sprung up, both in the service & manufacturing sectors. Large billboards offering wind-solutions can be seen in the metropolis.

Small manufacturers have also jumped in, to cut costs by local production. Indigenous designs of generation-turbines have been adopted for local production of micro-turbines upto 500 Watts. On the water-pumping side, multi-bladed turbines are being produced, along with the complete pumping system. Both types are therefore produced 100% locally.

In the service sector also, commercial firms are offering complete turn-key solutions for residential usage, either for bill reduction or to cater to the power shortfalls, using wind alone or wind plus solar hybrid system for non-windy days.

In short, the micro turbines have generated the following opportunities for local population:

- Coastal applications;
- Water pumping and agriculture;
- Urban applications;
- Service industry; and
- Manufacturing Industry.

## 6. MEGAWATT-CLASS

It is anticipated that wind farming would bring big employment-opportunities in the following areas:

- Soil-Survey (Highly Technical);
- Civil construction, skilled and unskilled labour, as well as engineering and consultancy in civil construction, infrastructure development, etc (Unskilled, skilled, technical and Highly Technical);
- Electrical Technicians. Skilled electrical wiremen, technicians, transmission-line workers, etc. (Technical);
- Wind Power consultancy in the field of wind-resource analysis, wind data-collection, site analysis, micro-siting, etc. (Highly Technical);
- Grid connection consultancy, for providing technical support to wind-farms in grid- connection (Highly Technical);
- Electrical machinery installation for sub-stations. This will include local manufacture of heavy duty transformers, etc.;
- Transportation and Insurance;
- Installation, Erection and Commissioning;
- Operation and Maintenance;
- Computerised data-collection;
- Accounts and legal;
- Administration and Security; and
- Other employment opportunities, like drivers, operators, data-collectors, etc.

Not much is being said here because these advantages have yet to be experienced.

Unlike the micro-turbine case, where both commercial activity as well as benefits of wind- turbines can be seen on the ground, the wind farms are yet to be erected and, hence, all the above are as so far only expectations. It may be added that some consultancy work, site survey and soil survey work, etc., has already been generated. Similarly, the transportation industry is gearing up for sea as well as land-transport of these bulky units.

Manufacturing in the megawatt class, the initial thrust would be manufacture of tower and blades locally. Some ground work has been done by the local heavy industry, in anticipation of the first project to be signed with a foreign manufacturer. The Pakistan Machine Tool Factory (PMTF) and the Naval Dockyard claim to possess the necessary infrastructure, as well as the required know-how. It may be added that there is at least one company that is working on manufacture and assembly of these large wind turbines in Pakistan. This will expedite the induction of wind turbines in the energy-sector. Currently, Pakistan is at the mercy of international market fluctuations.

**WIND TURBINE**

**Model WG - 500**

Salient Features

- Robust construction
- High output at low wind speed
- Hot dip galvanized for rust protection
- Suitable for battery charging
- Hinged vane safety system
- Sealed bearing no maintenance
- Simple operation and maintenance

## 7. SOCIAL UPLIFT

All the benefits described above may not be adequate to satisfy the locals who want to see immediate benefits of general nature. Many multinational firms in other projects have shown us the way by providing social amenities for the inhabitants of the area, such as schools and health units. The investors, both local and foreign, must be advised by the provincial governments to keep a certain percentage of the net after-tax profits for providing similar amenities to the local population.

If Greg Mortenson of 'K2 and Three Cups of Tea fame', an American who saw the plight of the locals in the Northern Areas of Pakistan, dedicated himself to providing education to the children of those areas, why can't the investors do the same? Today, Greg is running almost 150 schools in the North of Pakistan. Let us hope that, courtesy our investors, we will have 15 schools in the wind corridor.

## 8. RECOMMENDATIONS

In order to encourage the industrial and commercial activity to flourish in this emerging technology, the following recommendations are made:

- Exemption on import duties, custom levies, other duties, etc., may continue for at least the first ten years of this technology induction.
- Tax-holiday, in terms of sales tax, income tax and all other taxes, to encourage investors may continue for a similar period.
- Just as land is being leased for wind farms, it may also be leased on easy terms in industrial areas for related manufacturing concerns.
- Use of green energy (wind/solar/biomass, etc.), as a percentage of total energy being used, may be made compulsory for industries so that investment in these technologies can grow.
- Certain percentage of profit may be used, via NGOs, to provide civil amenities to the local population.

## 9. CONCLUSIONS

Induction of wind power will generate intense commercial and industrial activity, signs of which are already appearing with the induction of micro-turbines. The country should look forward to a positive social impact of this new technology.

# BIOGAS (NATURAL GAS): PAKISTAN'S VIABLE SOURCE OF ENERGY PRODUCTION

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**ABSTRACT**

*Unsustainable developmental activities lead to many long-term economic, social and environmental losses and, therefore, the income generation potential of the communities is greatly reduced, besides deterioration of quality of health and hygiene. Thus, there is an urgent need for adopting sustainable development policy and strategies. The agriculture, industrial and transport sectors are the major income-generation sources of Pakistan, and are facing problems due to energy crises. Pakistan is facing acute energy shortage and the available options for energy generation are mostly unsustainable, in terms of the economic, social and environmental aspects. As a result, the country is forced to undertake load management through load-shedding of over ten hours a day.*

*It is argued that decentralized biogas energy production, using animal dung, is highly sustainable, as it is economically viable and socially acceptable, besides being environment-friendly. Pakistan, with 30 million heads of buffaloes and 33 million cattles, can produce over 31.5 million $m^3$ of biogas per day and 11,497.5 million $m^3$ per annum. This huge untapped potential can prove to be a major source of income-generation in rural areas through energy-production, organic farming and selling the carbon-credits.*

## 1. INTRODUCTION

Pakistan is blessed with a highly diverse landscape, weather and climate that hosts plenty of natural resources. This ecological depth of Pakistan offers huge potential for sustainable natural resource-management. The rural population mostly follows agro-pastoral livelihood activities and supplies most of the agricultural and livestock/dairy products for national consumption, in addition to production of cotton and rice for export. Despite possessing enormous natural resources, Pakistan is facing the problems of food security, unemployment and energy shortage. Focusing on the decentralized renewable energy potential in Pakistan, an effort is made to analyze how Pakistan's energy-crises could be solved using indigenous resources and technical knowledge.

Pakistan followed the world in adopting environment and development initiatives right from the Stockholm Conference on Human Environment in 1972 through the Rio Earth Summit in 1992, to the World Summit on Sustainable Development held in Johannesburg in 2002. The objective was to protect the environment from various anthropogenic developmental activities leading to sustainable development through conservation, adaptation and mitigation. To this effect, Pakistan has taken a great deal of institutional and programmatic and strategic measures; Pakistan included environment in the concurrent list of the constitution of Pakistan (1973), promulgated the Pakistan Environment Protection Act (1997), ratified over a dozen of Multinational Environment Agreements, implemented the National Conservation Strategy (1992), National Action Plan and National Environment Policy of 2005.

## 2. BIOGAS: A VIABLE OPTION FOR PAKISTAN

Traditionally, Pakistan's major power-generation sources are hydroelectricity, fossil fuels, coal and nuclear-power plants, and are primarily relying on centralized mega energy- generation systems, which are very costly for a developing country like Pakistan. Therefore, as a result of increased energy demand, Pakistan is facing energy crisis due to lack of resources for developing mega power-generation systems. In addition, the oil and gas resources, besides being costly, are non-renewable and, therefore, not sustainable over longer periods of time. Pakistan possesses the potential of hydropower generation in Khyber Pakhtunkhawa (KPK), Northern Areas, and Azad Jammu & Kashmir, besides some wind-energy potential in the coastal belts of Sindh and Balochistan. But these sources of power and energy would require huge financial resources for proper utilization, even if we go for small and medium-scale systems. Solar energy technology is highly technical and costly and is still in the process of development.

Biogas typically refers to a gas produced by the biological breakdown of organic matter in the absence of oxygen. Biogas is the product of food-chain, in which the solar energy is trapped by green plants that are eaten by livestock as fodder to produce energy, fats and carbohydrates that the animal body uses. The waste product that is disposed off contains a lot of carbohydrates, which are the major source of methane ($CH_4$) produced during the process of dung-fermentation by anaerobic respiration of bacteria. Biogas originates from biogenic material and is a type of bio-fuel, which primarily comprises methane and carbon dioxide. Biogas can be used as a low-cost fuel for heating, cooking and power generation. It can also be compressed, much like natural gas, and used to power motor vehicles. Being a renewable source of energy, biogas qualifies for renewable energy-related subsidies in some parts of the world. Biogas consists of the following gases:

| | |
|---|---|
| Methane ($CH_4$) = 50-75% | Hydrogen ($H_2$) = 0-1% |
| Carbon dioxide ($CO_2$) = 25-50% | Hydrogen Sulphide ($H_2S$) = 0-3% |
| Nitrogen ($N_2$) = 0-10% | Oxygen ($O_2$) = 0-2% |

Biogas offers cost-effective and decentralized energy-production option at community and household levels. Pakistan tried out production of biogas in the nineteen seventies, but it could not succeed due to inadequate technical know-how and lack of awareness among the communities. Recent technological advancements in biogas-digesters have greatly helped in developing a highly efficient, economically viable, environment- and user-friendly biogas plant, which is successfully being demonstrated and used. This Chinese model of dome-shaped concrete biogas plant is successfully being used in China, India and, recently, in Pakistan for biogas production, using cow dung.

Biogas is extensively produced in China and India using anaerobic digestion techniques. In rural China, anaerobic digesters are used to provide energy for households, as well as producing agricultural fertilizers. Other benefits of this system include improved sanitation and conservation of alternative fuels. There are approximately five million households using anaerobic digesters in China.

## 3. FEASIBILITY OF BIOGAS PLANT

A small and medium-scale domestic biogas plant costs not more than 50-70 thousand Pak. rupees and can be constructed even in the courtyard of a rural house. It can generate 10-20 cubic meters of natural biogas, which possesses 50-75% methane, a major source of energy that burns instantly and produces heat. The biogas could also be used to produce electricity, with little alteration, using common petrol generators. It has been observed that an average household uses LPG and fuel-wood equivalent to Rs. 4,000 per month. Mostly, rural households use dried cow-dung cakes as a source of domestic energy, which not only deprive the agricultural lands from organic manure, but also lead to tuberculosis due to emission of dangerous gases that one inhales. Thus, biogas can directly save Rs. 4,000 per month a month as alternate source of energy, moreover relieving them from the average cost of chemical fertilizer of Rs. 1,000/acre, as the decomposed manure is a rich source of organic fertilizer.

Pakistan, with 30 million heads of buffaloes and 33 million cattles, can produce over 31.5 million $m^3$ of biogas per day and 11,497.5 million $m^3$ per annum. Pakistan has almost 10 million potential livestock-owning households: enough to keep the small and medium biogas plants running. This huge untapped potential can prove to be a major source of income- generation in rural areas, through energy production, organic farming and selling the carbon credits that they will earn under the Kyoto Protocol, besides reducing emissions of the greenhouse gases into the atmosphere. It is argued that decentralized biogas energy production, using animal dung, is highly sustainable, as it is economically viable, socially acceptable, besides being environment friendly. Each buffalo head gives 15 kg of dung in a day, which can produce 0.5 to 1 $m^3$ of biogas (natural gas). A rural household possessing an average of five livestock heads can produce 2.5 to 5 $m^3$ of biogas, sufficient for their daily energy needs, besides producing decomposed humus as a rich source of organic manure. Such decentralized energy-generation stations will not only save the cost of installation of transmission-pipe and electricity poles, but will also save the foreign

exchange that we spend on importing LPG and other fuels. Being the 5th largest livestock and dairy-producing country, Pakistan can easily adopt these technologies, at household and community levels, to ensure energy- security in rural areas.

## 4. CONCLUSION

Adoption of the simple biogas technology by the livestock-owning households can increase the income of the poor rural communities, in addition to increasing organic production. Organic agricultural products can reduce the health-bill of rural communities and, thus, help in promoting sustainable production and consumption. These decentralized energy-production units can bring self-sufficiency to the rural households, save forests from being cut for fuel-wood, provide organic fertilizers to the soil, thereby increasing its fertility, besides reducing environmental pollution.

We must try our best to promote this highly sustainable production of biogas energy in rural areas. The Government of Pakistan, local and international donor-agencies interested in poverty-alleviation, decentralized alternate energy development and rural development may look into tapping this huge potential of alternate energy in order to get Pakistan out of the present energy-crisis and bring prosperity to the communities living in rural areas. This will greatly help in reducing energy-crisis of Pakistan in the shortest possible time, compared to developing other sources of energy.

# EMPLOYMENT GENERATION THROUGH BIO-ETHANOL PRODUCTION SECTOR

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**ABSTRACT**

*The volatile international oil prices, depleting natural gas reserves and environmental concerns are compelling Pakistani decision-makers to consider ethanol as an alternative option. The transport sector has a 28% share in the total commercial energy consumption. Pakistan needs to develop indigenous, environment-friendly energy resources, such as ethanol, to meet its energy-needs with creation of jobs. The sugar sector has the capacity to produce over 2.5 million metric tons (MMT) of molasses, available for processing into ethanol. Country-wide, nineteen distillery units are operating, each providing employment to 60 persons on the average. Ethanol can be used in the transport sector after blending with gasoline, in order to minimize the consumption of gasoline and save foreign exchange for the nation.*

## 1. INTRODUCTION

As we enter the new millennium, Pakistan faces two major problems, huge import-bill for fuel (petroleum products) and single product-based sugar industry. Apparently, there seems to be no correlation between the two problems, but there is a single remedy for both. Alternate renewable clean-burning fuel (bioethanol) can solve these twin problems [Kazmi, S.H., 2004]. The crying need of the day is energy, more energy and cheaper energy, which in simple terms mean fuels, more fuels and cheaper fuels. The ever-increasing expenditure on fuel-oil imports is causing economic imbalances, price hikes and hardships for the people. Moreover, the growing use of petroleum fuels in the ever-increasing number of automobiles is causing rapid degradation of the environment and air-pollution in our major metropolitan cities, due to vehicular emissions.

At the moment, the most prominent eco-friendly biofuel candidates are bioethanol and biogas, with potential of employment-generation throughout the country. Sugar factories are seasonal, but distilleries run throughout the year – a way of permanent and secure employment. The manufacture of alcohol and alcohol-related products makes a significant contribution to the economy. For example, alcohol is the most heavily taxed product in Pakistan. The number of jobs provided by this industry makes

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it an important source of income for the nations [Arshad, M., 2005].

Currently, Pakistan's oil-import bill eats up a major chunk of its precious foreign-exchange reserves. As an agricultural country, with mounting trade deficit, Pakistan needs to focus on substituting imported oils with ethanol fuel, which is an appropriate replacement for gasoline. This gasoline-substituting ethanol fuel can be produced locally and we would not have to rely too heavily on imported fuel, thus saving the foreign exchange along with the support to the local industry and people. Moreover, we can also shift the burden from natural gas, whose consumption is increasing at a much faster pace than its production. Besides, we can appropriately address environmental issues, such as emission of dangerous gases due to the use of gasoline, by adopting ethanol as an alternative fuel [Sibtain, R.K., 2009].

For developed countries, biofuels offer prospects for meeting their emission-reduction commitments under the Kyoto Protocol and a means to reduce energy-import bills as well as earn precious foreign exchange [Shaheen R.K., 2007]. The interest of Pakistan's sugar industry in alcohol-production technology is natural. Molasses production remained between 1.3 million tons and 2.1 million ton during the last ten years, while export of molasses remained at 1.3 to 1.748 million tons. So, there is a great potential to use sugarcane by-products, like molasses, for producing ethanol. It would contribute significantly to the economy [Press Release - May 03, 2005].

This paper is presenting the potential employment-generation through production of bio-ethanol and biogas from molasses in Pakistan. Use of biogas for power-production will also be shown. Case-study of a sugar mill (Shakarganj Mills Ltd.) in Pakistan, producing both biofuel and power by processing the sugarcane molasses is presented here.

## 2. GLOBAL INTEREST IN BIOFUELS

An accelerated release of fossil-entombed $CO_2$ due to human activity is now generally accepted as a major factor contributing to the greenhouse effect [IPCC, 2001]. Approximately 28% of the energy available for consumption in the EU25 countries is attributed to transportation, more than 80% of which is due to road transport [Eurostat, 2007]. In Pakistan, it accounts for about 28% of the total energy consumed and 55.8% of the total petroleum products consumed [Harijan, K., et al, 2009]. About 27% of primary energy is used for transportation worldwide, which is also the fastest growing sector [EIA, Office of Integrated Analysis and Forecasting, 2006]. Transportation-fuels are thus promising targets for a reduction in greenhouse gas emissions. The production of chemicals and fuels from the locally grown plant-material supports political independence, through diversification and a decreased dependence on a few energy-sources; a $CO_2$-neutral energy production and a surplus of gross national product. This is especially crucial to remote and economically disadvantaged agricultural areas [Antoni, D., et al, 2007]. Ethanol, blended with

gasoline in grades E10, E85 and E100, is being used widely in the United States, Europe and Latin America, respectively. Though it can be produced from various feedstocks, such as bagasse, miscanthus, rice husks, wood waste, sorghum, barley, hemp, kenaf, sunflower, corn, cotton and other biomass, its production from molasses (a byproduct of sugar) is considered as most cost-effective. Non-toxic, water-soluble and biodegradable ethanol is also considered as environment-friendly and as one of the best fuels to fight air-pollution from vehicles. It contains 35 per cent oxygen that helps in reducing harmful exhaust gases like carbon monoxide by as much as 30 per cent and particulate matter by as much as 50 per cent. This fuel not only provides higher octane-content, without any presence of lead, but also substantially reduces the greenhouse gas emissions [IEA, 2004].

## 3. POTENTIAL FOR EMPLOYMENT-GENERATION

Bioethanol fermentation is, by far, the largest scale microbial process. State-of-the-art industrial production of ethanol uses sugarcane molasses, in batch fermentation with yeast *(Saccharomyces cerevisiae)*, to create ethanol. Byproducts of this process are $CO_2$ and small amounts of methanol, glycerol and acetic acid, etc. [Nissen, T.L., et al., 2000]. The sugar industry in Pakistan is the second largest after textiles; 76 sugar mills are currently-operating, at or below their capacity. The emerging markets of industrial alcohol and fuel-ethanol offer prospects of making sugarcane production economically viable [Shaheen, R. Khan., 2007]. Currently, 21 distilleries produce industrial alcohol in the country. As many as eight distilleries have so far installed the molecular-sieve technology to process industrial ethanol into fuel ethanol. Most of these distilleries are a part of sugar mills and are situated on-site, making the production-cycle an integrated one. The mills receive the cane, crush it for sugar, store the molasses in storage tanks on-site and then pass it on to the distilleries for industrial-alcohol production. Industrial alcohol can be converted into fuel alcohol by using molecular-sieve technology, which requires a capital expenditure of about $1.5 million and a completion-period of five to six months [Shaheen, R.K., 2007].

Distilleries are a source of additional employment. Direct employment in a distillery unit is approximately 60 persons. Persons having different backgrounds, like Biochemistry, Microbiology and Chemical Engineering, are required for the operation. Undoubtedly Pakistan is an agricultural country and has an immense potential to produce ethanol fuel. The existing production-capacity for fuel-grade ethanol in the country is 270,000 tonnes per annum, which can be easily increased to 400,000 tonnes per annum, with the increase in jobs. However, the bulk of raw molasses is exported, and only minor quantities are converted into industrial alcohol for domestic use and exports. By exporting molasses, we earn only US$100 million, while by using raw molasses to produce blended ethanol fuel, we can save precious foreign exchange of about US$600 million [Sibtain, R.K., 2009]. In addition to the loss of this foreign exchange, we lose the employment-opportunities for the people of our country. Pakistan produces about 54 million tonnes of sugarcane every year. The

estimated production-potential for ethanol from molasses is about 500 million litres per annum [Harijan, K., et al, 2009].

## 4. USE OF ETHANOL AS BIOFUEL IN PAKISTAN

Pakistan State Oil (PSO) has launched E-10 gasoline pilot-project at designated retail outlets in Karachi, Lahore and Islamabad. It is based on a detailed feasibility study conducted by the Hydrocarbon Development Institute of Pakistan (HDIP). The new fuel – 10% ethanol blended with motor gasoline – is being introduced experimentally as part of the government's strategy to promote alternative energy resources. The pilot-project was conducted for 6 months, with 25 pre-identified vehicles using ethanol-blended gasoline, in each city. The monitoring of these vehicles was carried out by HDIP. Based on the results of the project, the blended fuel would be made available throughout the country. Pakistan's sugar industry has a capacity of producing four billion litres of ethanol annually [Umar, et al., 2008].

In July 2006, PSO took the initiative to launch the pilot-project of ethanol filling-station in Pakistan. Although PSO, in collaboration with HDIP, initiated a pilot-project to introduce ethanol fuel blended with gasoline in a 1:9 ratio (E10) at three petrol pumps in Karachi, Lahore and Islamabad, but this venture failed due to the lack of coordination among various stakeholders, and gaps at the planning and implementation stages. The Economic Coordination Committee (ECC) of the Federal Cabinet has decided to allow marketing of Ethanol-10 as motor vehicle fuel, on trial basis, at PSO stations.

The ECC met under the chairmanship of Shaukat Tareen, Adviser to Prime Minister of Pakistan on Finance and Economic Affairs, at the Prime Minister's Secretariat. The decision to allow marketing of E-10 was taken to reduce reliance on imported petroleum products, to the extent possible through use of appropriate indigenous blendable substitutes. Anhydrous Ethanol (Ethanol with less than 1% water) is one such product, which can be blended with gasoline in varying proportions. Most gasoline vehicle engines operate well with a mixture of 10 per cent Ethanol (E-10).

The ECC further decided that E-10 would be treated as motor-vehicle fuel. The Government of Pakistan imposed a 15% duty on molasses' export, which would favour the use of molasses for ethanol-production rather than export.

## 5. A CASE-STUDY OF SHAKARGANJ MILLS LTD

Shakarganj Mills Ltd. (SML), is one of Pakistan's leading manufacturers of refined cane- sugar and co-products, located in Jhang at three hours drive west of Lahore. Its most important products are:

- Sugarcane crushing capacity 12,000 tonnes/day;
- Ethanol production 2.6 million litres/year;

- Building products 2 to 4.0 $m^3$/year;
- Biogas power-plant production 8MWh.

Diversification into ethanol has reduced the company's dependence on sugar and brought a balance to its product-mix. Almost 80% of the ethanol is exported, increasing the nation's foreign exchange earnings. During the year 2004, foreign sales were Rs. 477 million and the company is expecting a further increase in future [Rizvi, J., 2005].

### 5.1 Methane/Biogas

The distillery effluent is fed to biogas digesters, combining energy-production with waste- water treatment [Cliff, B., and Ken, R., 1984]. The energy supply from distillery stillage has multiple advantages, so that it not only eliminates the environmental pollution but also saves fuel/power cost in manufacturing/processing in the ethanol industries. Biogas plants produce methane gas sustainably, alongwith carbon dioxide from plant-biomass, which may come from organic household or industrial waste or from especially grown energy- plants [Yadvika, et al, 2004]. As far as its economic benefits are concerned, the waste- treatment process of ethanol fuel is not only cost-effective, but also environment-friendly. The organic components of the wastewater are converted into biogas methane and carbon dioxide with negligible sludge-production, through anaerobic (wastewater treatment) process. The produced methane gas can also be recycled as an energy-source in distilleries to meet 70-90 percent of the total energy-requirements. The final discharge, after being diluted with subsoil saline water, can also be used for land irrigation [Sibtain, R.K., 2009].

In effect, distilleries have a 'closed carbon cycle'. The final discharge, when diluted with subsoil saline water, has BOD and COD concentrations reduced by as much as 97 per cent and can be used for land irrigation. The environmental gains from wastewater-treatment are thus obvious, while the cost-savings incentives to distilleries are written in. Electricity- generation is considered the most suitable way for commercial exploitation of biomass, by virtue of the high cost of electricity. Biomass-based electricity schemes already provide over 9GW(e) of worldwide electricity-generation. Cogeneration technology, based on multiple and sequential use of a fuel for generation of steam and power, is a viable option for power-generation in process-industries, such as sugar, paper and rice mills.

### 5.2 Biogas at Shakarganj Mills Ltd., Jhang

Basically, biogas plants comprise 3 main sub-systems:

i. Digesters, producing biogas from waste water / organic solid waste material;
ii. Conditioning the biogas (ScanAirclean);
iii. Generator sets or boiler steam-turbines converting the biogas into electrical power and heat.

SML's biogas plant was built in 2003 by engineering services from Ecoboard Industries, Ltd., Pune, India. The biogas plant comprises 5 fully mixed digester (CSTR) tanks (each above 12,000 $m^3$), gas holder and control room.

### 5.3 Power Production from Biogas

Before the construction of the powerhouse in 2008, biogas was used in boiler steam-turbines producing 2 MWh power. Eight gas-engines were purchased from Jenbacher Engines, Austria, and installed, each generating 1MWh. SML obtained a power-purchase agreement with WAPDA to sell this excess 8 MWh electricity to the national grid. These generators are stepped-up from 0.4 kV to 11 kV for export to national grid. Presently, the power produced is exported to local grid, thus solving the problem of load shedding in that area.

### 5.4 Employment at Distillery and Biogas Units of Shakarganj Mills Ltd., Jhang

From the year 2000, the Shakarganj Distillery is in continuous operation. At the distillery unit, there were a total of 110 persons employed. In year 2003, a biogas plant was installed and in 2008 power production started. Fifty people are employed at the biogas plant and its power-house. The boiler house and power house have 50 persons for the distillery operation. Collectively, more than 200 persons remain on job, round the year, for the operation of the distillery plant and related units.

### 5.5 Environment

Ethanol from molasses has a closed cycle, where energy for the refinery and distillery process comes from sugarcane-residue and waste; hence no fossil fuels are needed. For every energy unit invested, molasses' ethanol yield is 8.3 units in Brazil, followed by the sugarbeet which yields 1.9 energy units in France for every unit invested [Kruglianskas, I., 2006].

Air pollution from the use of gasoline and diesel oil in automobiles is increasing with the increasing number of vehicles. Most motorcycles and rickshaws, with their two-stroke engines, are the most inefficient in burning gasoline fuel and contribute most to emissions [Harijan, K., Et al., 2009]. Use of ethanol as fuel can reduce these greenhouse gases almost 20% to 50%, compared with petroleum fuels [Rashid, M.T., and Altaf, Z., 2008].

As a renewable energy project, the biogas power-plant is eligible for carbon credits, because it enhances energy-efficiency at the mill and displaces the national grid's energy generated from fossil fuels. By using the biogas instead of fossil fuels for power generation,
the plant is expected to produce approximately 20,000t of certified emissions-reductions (CERs) annually, under the Kyoto Protocol [www.powertechnology.com].

The heat production from the exhausted gas of biogas engines will generate saturated steam upto 3 tonnes/hr and can be used to support the company's distillery process. The treated water released from biogas is being used for irrigation.

## 6. CONCLUSION

Bioethanol and biogas produced from sugarcane molasses are sustainable energy resource, with the greatest potential for $CO_2$-neutral power; the local industry growth; and creation of jobs. Therefore, there is a tremendous potential for their application in Pakistan. There is a need to allocate necessary resources for improving these technologies and to plan their widespread dissemination. Better coordination between sugar mills is required to install more plants.

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# EMPLOYMENT GENERATION THROUGH ENERGY CONSERVATION TECHNIQUES IN STEEL INDUSTRY

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**ABSTRACT**

*The generation of employment-opportunities in Pakistan is probably the single most crucial problem and certainly the most pressing social issue faced by the society today, which needs to be addressed immediately. The unemployment scenario, particularly noticeable among the educated rural youth, imposes a huge burden on the society, in terms of social unrest and deterioration of law-and-order situation. This problem can only be tackled by adopting absolutely fresh approach that needs alteration in the policy framework. One such approach could be to recognize "Energy Conservation" as a hub for integrated rural economic growth and as a tool of multi-discipline employment-generation planning.*

*This approach requires improvement in the governance in energy-sector to be addressed at all levels. Good governance can be practiced in the energy-sector through people's active participation, administrative reforms, professionalism, capacity building, training, and procedural reforms. It is the need of the hour that people do not stay mere spectators or beneficiaries of the government's development programmes but, instead, they own, develop and operate commercial ventures instilling energy-conservation to meet their own energy-needs, as well as fulfilling the demands of the whole nation. This paper analyzes the current energy-situation in Pakistan and proposes a solution to the problems being faced.*

## 1. INTRODUCTION

The youth, constituting more than one billion of the world's population, represent its greatest asset for the present and future. Nearly 85 per cent of the total youth are facing serious vulnerabilities all over the world, particularly in the developing countries. The increasing global unemployment in recent years has been felt more by young people than any other group. Between 1993 and 2003, the number of unemployed youth, worldwide, increased steadily to reach an all-time high of eighty-eight million by 2003. In 2003, the youth represented 47 per cent of the total unemployed, while their share in the working-age population was only 25 per cent. South Asia was a home to 13.9 million of the unemployed youth in 1993 that increased to 16.96 million by 2003 – a

rise of 21.8 per cent. Tracking the unemployment rate for youth and setting a target for its reduction, alongwith understanding the labour-market dynamics of this segment of the population and identifying policy- interventions, has assumed added importance and urgency, since its incorporation in the UN's Millennium Development Goals for 2015.

In Pakistan, the decade of the nineties was marked by rising unemployment, due to low rates of economic growth as well as the consequence of fiscal tightening. The restructuring and privatization of public-sector enterprises, carried out under the WB/IMF Structural Adjustment Programmes, resulted in layoffs of surplus staff, further aggravating the unemployment situation in a period of depressed economic growth. Open unemployment increased from 4.7 per cent in 1992-93 to 8.3 per cent in 2001-02. It decreased marginally to 7.7 per cent in 2003-04. During the same period, youth unemployment nearly doubled from 7.6 per cent in 1992-93 to 13.6 per cent in 2001-02 and then declined to 11.7 per cent by 2003-04.

## 2. SITUATION IN PAKISTAN

The Medium Term Development Framework 2005-10 (MTDF), approved by the Government of Pakistan, envisages youth unemployment rate of 6.1 per cent by the end of the MTDF period (Figure-1).

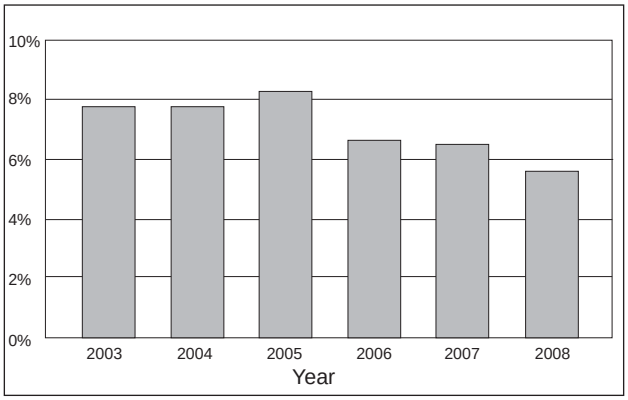


**Figure - 1: Rate of Unemployment (2003 to 2008) in Pakistan**

The continuing power crisis has not only disrupted the daily lives and businesses of people, but has also added to their miseries. It has impeded the growth of both small-scale and large-scale businesses. Industrial progress is in shambles, owing to the unpredictable and unreliable power-supply. People are forced to deal with the day-long interruptions in electricity and have to suffer in the intolerable heat and humidity, with no logical solution in sight. Electricity is a necessity in the fast-paced modern society and its shortage not only dampens the spirits of the people, but also hampers their productivity. It would not be wrong to say that the frequent power breakdowns

have brought both the domestic and social lives to a standstill. The shopping malls and the open markets that were once swamped by the customers are now dark and deserted, resulting in greater unemployment in every field.

## 3. UNEMPLOYMENT SCENARIO

The single most crucial problem, and certainly the most pressing social issue facing Pakistan, is probably the availability of adequate employment opportunities and it needs to be addressed immediately. This problem has been aggravated over the years and is likely to assume alarming proportion in the near future, given the demographic picture of 55 % of the population comprising young persons less than 35 years of age in the country. If this is an exciting number, it is equally scary. The matter of real concern is: How are we going to harness this youthful energy and enthusiasm, to be put to good use for the benefit of the nation?

As of now, there are thousands in the twenties with nothing to do and nowhere to go. They drift aimlessly, with hopes in their hearts and frustration in their eyes. There is nothing more threatening than a vacant mind. The unemployment scenario, particularly noticeable among the rural educated youth, imposes high burden on society, in terms of social unrest and deterioration of law & order situation.

On the issue of unemployment, a senior Pakistani columnist has observed, "We just do not have the capacity to employ even the youth who would enter the job-market, let alone find jobs for those who are already waiting to be employed unless, of course, we radically change the course of our current economic policy and perhaps alter the very strategy of development".

## 4. A SOLUTION: ENERGY CONSERVATION

In a globalizing and increasingly competitive world, sustainability-related risk-exposure and business opportunities vary widely between and within sectors. It is about how we manage key environmental, social and governance risks, how our businesses create sustainable value, how we include sustainability in our business-processes and how we use this as a competitive advantage to accelerate growth. Energy conservation and focus on climate-change has to be a top lead-process, with a clear policy-commitment and strong management-systems in place. It is vital to include this in an organization's operational model to ensure that it is steered properly and given due weightage.

A new approach has to be followed. Through energy conservation, not only can we make the existing industries more efficient, but also create opportunities for other companies to utilize that saved bit of energy, hence, increasing employment. A systematic approach has to be followed, which could be done by:

- Measuring and monitoring major energy-consumers;
- Carrying out energy-audits to evaluate the performance of inefficient

equipment(s) and providing alternate solutions for improvement;
- Identifying opportunities to reduce energy, by modifying operational methods; and
- Preparing year-on-year capital-investment plans that directly impact energy-efficiency.

As an example, we consider the work done by the College of Electrical & Mechanical Engineering (CEME), NUST (Pakistan). The CEME, with help from Frontier Foundry (FF), has embarked upon an initiative to address issues of energy-efficiency and environmental compliance in the foundry sector. The issues are being addressed through the process of demonstration of heat-recovery technologies. The results of this project will not only increase efficiency, and production and reduce the fuel-consumption; it would also serve as a pilot-project for the entire steel-production sector in Pakistan. The implementation of these technologies not only addresses the issues, but also makes business sense. Due to insufficient raw materials and high-energy costs, the steel industry has been a constant topic for decades. Numerous technological developments have contributed towards minimizing the production and utilization of steel, while maximizing its yield. This efficiency means optimization of the relationship between resource methods, machines, materials and products or processes. Another important development in the industrial sector has been the increasing focus on the environmental compliance. The foundries, grappling over the last several years with cutting down costs and streamlining operations, have not been in a position to implement the environmental standards. Compounding the problem is the lack of effective and economical technological solutions to the problem.

### 4.1 Heat-Recovery System

A heat -recovery system from fluid gases often consists of a recuperator, i.e. a heat-exchanger, absorbing and transferring heat into another fluid. If the heat is directly returned into the primary process, typically by pre-heating, the combustion-air, energy is conserved (Figure-2).

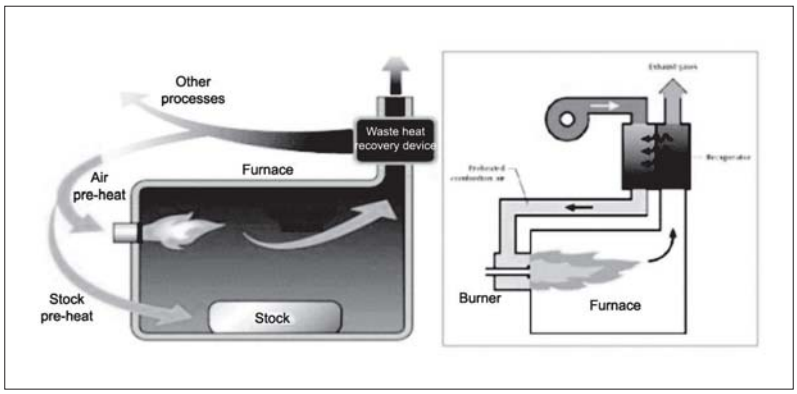


**Figure - 2: Heat Recovery System for Energy-Conservation**

Energy used in producing steel is nearly ten times the practical minimum. When pre-heated air is used for combustion in the furnace, this can result in fuel saving up to 40%. When cost is converted into monetary terms, it is a huge profit for the foundry. Energy saved can then be used to open up new industries that will provide job-opportunities to more people.

Here we take the example of ICI, a leading company in Pakistan. They set a target to decrease the energy-consumption per tonne of production. The Figure-3 shows that ICI saved 25 Terajoule per tonne of production in 2008, compared with the figures for the year 2000. It is a huge amount of energy saved. If other companies follow this example and do their part for energy conservation, more energy will be available for any new investor who wants to invest in some sector, hence increasing the job-opportunities.

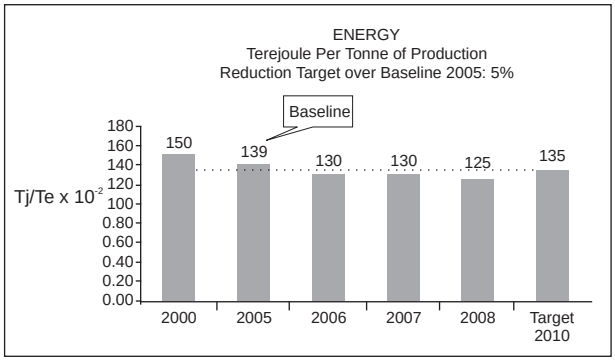


**Figure - 3: ICI's Reduction in the Energy Construction Per Tonne of Production Since 2000**

## 5. EMPLOYMENT-GENERATION POTENTIAL

Conservation of energy ensures that power is available to everybody at affordable prices. When you are saving fuel for electricity, consumed in any industry, the load on our power- production units will decrease. The availability of affordable and quality power will, in addition, trigger the entire rural economic growth milieu in the region, and accelerate generation of additional employment-opportunities in sectors like, agriculture, horticulture, manufacturing, construction, mining, trade, hoteling, transportation and communications. Electricity is an essential input for agriculture, no less important for industry and services. The large proportion of the farm produce, particularly fruits, vegetables, and flowers that perish, requires establishment of reliable refrigeration and cold-storage facilities. The overall result of this approach would be to not only provide gainful employment to a large number of the existing unemployed labour-force, but to achieve a higher employment growth-rate per annum.

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# AEDB'S JOB-CREATION EXPERIENCE: INSTALLATION OF SOLAR HOME SYSTEMS (SHS) IN RURAL BALOCHISTAN

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**ABSTRACT ONLY**

**ABSTRACT**

*There is a rising need for alternative and renewable-sources of energy around the globe, especially in developing countries like Pakistan. Keeping in view the development of rural areas, Alternative Energy Development Board (AEDB) of Pakistan had initiated a project to provide villagers in Balochistan and Sindh with the comforts of lighting, cooking and water disinfection by employing solar-energy technologies. This project demonstrates PV utility for small power-requirements and remote-area applications.*

*Through the project, the Board has electrified 11 villages in all the provinces of the country; each individual house has been given its own Solar Home System (SHS). In each village, a local operator was appointed to collect monthly fees of Rs. 150-200 for each house from village community and has been made responsible to operate and maintain it. Specifications of the Solar Panel are: 80 Watt, Charge Controller, Battery, 4 CFL lamps, 2 LED lights, a 12 Volt DC fan and a TV socket. The solar panel charges the battery during daylight hours, and the stored energy is used to run the electrical appliances throughout the day and night. The user is only required to switch the lighting system on/off, as is done in regular home lighting systems.*

# Agriculture and Biotechnology

# COAL BIOTECHNOLOGY: A STEP TOWARDS SUSTAINABLE ENERGY DEVELOPMENT AND EMPLOYMENT GENERATION

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**ABSTRACT**

*In the immediate future, Pakistan will have to rely largely on fossil fuels in energy-sector, especially on coal because of its availability and reliability. Coal is the most significant contributor of primary energy sources, with proven reserves of 63% among fossil fuels in the world, and it is mainly being used as a fuel in thermal power generation, cement industries, in brick kilns, and as a chemical feedstock for various industries, such as fertilizers and metallurgical operations. Currently, the share of fossil fuels in the world energy-mix is 88% and coal shares about 30% of the mix.*

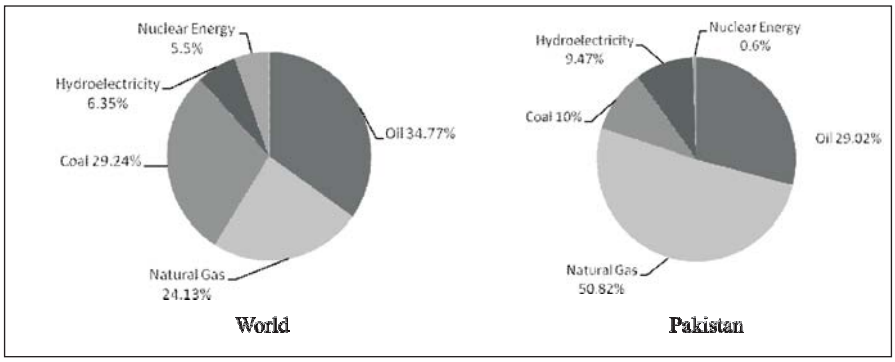
*Pakistan has been endowed with huge reserves of coal (185 billion tonnes) but unfortunately the contribution of coal is only 10% in the energy mix of Pakistan. The reasons behind this minor share are high sulphur-content and lignitic nature (low ranking coal). The sulphur content of coal, which normally varies from 3 to 15% in local coal- reserves, limits its industrial application, due to environmental as well as technical problems. However, the novel coal-conversion technologies, like coal biotechnology, have emerged as a solution to the problems faced in coal utilization. Coal biotechnology offers environment-friendly processes, lower operating costs, less stringent processing-conditions and cost-effective commercial-scale processes.*

*NIBGE has long term interests in coal biotechnology, which generally refers to biodesulphurization, biosolubilization and biogasification of coal. A prototype of 300 tonne coal-heap was set up with a local cement industry and 70% microbial desulphurization was achieved after successful demonstrations at laboratory scale. The microbial desulphurization can have the potential in terms of US $ 7 per tonne with respect to hydro- and flue gas desulphurization. Similarly, keeping in view the significance of the huge lignite reserve (Thar Coal, 175 billion tonnes), coal biosolubilization and biogasification is also being worked on NIBGE. Currently, in Pakistan imported coal is available at the landed cost of US $ 180 per tonne, as compared to the local with US $ 103 per tonne. Keeping in view the total landed cost of imported and local biotreated coal almost US $ 70 per tonne can be saved, which makes a handsome amount (regarding high sulphur-coal reserves of Pakistan). In short, coal biotechnology,*

*which is at the verge of commercial upscaling, has great potential in our country, in terms of employment-generation for all levels of skills and education. It is recommended that implementation of coal biotechnology must be included in our national long-term policies, in order to boost our economy through relying on indigenous energy resources and reduction in oil and coal import bills of Pakistan.*

## 1. INTRODUCTION

A future with sustainable energy minimizing the adverse impacts on environment and maximizing the social and economic benefits, is a significant challenge for the present day, especially because of rising energy demands. Over the last ten years, world primary energy demand has risen by over 20% [Ahmad, et al, 1986]. The compendium of fossil fuels, i.e., natural gas, oil and coal, will be playing a dominant role in energy consumption; 80% of energy needs will be met by these conventional sources. Currently, 87% of energy needs are fulfilled using fossil fuels (Figure-1) [BP Statistical Review of World Energy, 2009].




**Source:** *BP Statistical Review of World Energy - 2009*

**Figure - 1: Primary Energy Consumption – World vs. Pakistan**

The increasing demands on oil and gas reserves and their subsequent depletion are leading towards higher costs of these fuels and instability in the energy sector. On the other hand, coal seems to be the most important consideration and fuel for power-generation and other uses, because of its affordability, reliability, availability, good geographical distribution in politically stable regions, and easier and safer transportation. The growing use of coal in the largest and fastest growing economies, China and India, depicts the magnitude (Coal share for both countries is above 70%) of prominence of coal in energy sector, particularly for those countries with huge reserves of coal, like Pakistan. Pakistan has been endowed with huge reserves of coal (185 billion tonnes) but unfortunately the contribution of coal is only 10% in energy mix of Pakistan [BP Statistical Review of World Energy, 2009; Gockay, C. F., et al, 2001]. The reasons behind this minor share are high sulphur-content and lignitic nature of coal (low ranking coal). The sulphur-content of coal, which normally varies

from 3 to 15% in local coal reserves, limits its industrial application, due to environmental as well as technical problems.

## 2. BIOTECHNOLOGY AS AN EMERGING TECHNOLOGY

Biotechnology is supposed to contribute greatly in coal-beneficiation processes. The scope of this unconventional approach appears as a solution for dilemmas faced during traditional operations. Bioprocessing of coal offers considerable and numerous advantages over conventional technologies [Prayuenyong, P., 2002]. Lower processing- costs, less stringent conditions and cost-effective commercial processes are major benefits, which can be achieved by application of biotechnology in the field of fossil-fuel beneficiation. Moreover, it can greatly help in employment generation, which, eventually, would result in improvement of national economy. Considering the importance and future prospects of coal in Pakistan's energy mix, a process, related to biodesulphurization of coal has been developed and upscaled in NIBGE.

**Table - 1: Characteristics of Major Coal-fields of Pakistan**

| Province | Location | Reserves (Million tonnes) | Type | Calorific Value (Btu/lb) | Sulphur Range (%) |
|---|---|---|---|---|---|
| Sindh | Thar | 175,506 | Lignite B to Sub-bituminous A | 6,244 to 11,054 | 0.4 to 2.9 |
| | Lakhra | 1,328 | Lignite B to Sub-bituminous C | 5,503 to 9,158 | 1.2 to 14.8 |
| | Sonda-Thatta | 3,700 | Sub-bituminous C to High Volatile B Bituminous | 8,878 to 13,555 | 0.2 to 15.0 |
| Balochistan | Sor-Range-Degari-Sinjidi | 50 | High Sub-bituminous A to High Volatile B Bituminous | 11,245 to 13,900 | 0.4 to 5.6 |
| | Chamalang | 6 | High Volatile C Bituminous to High Volatile A Bituminous | > 12,000 | 4 to 7 |
| | Khost-Shahrig-Harnai | 76 | Sub-bituminous B to High Volatile A Bituminous | 9,637 to 15,499 | 3.5 to 9.55 |
| Punjab | Salt Range | 235 | Sub-bituminous A to High Volatile Bituminous | 9,472 to 15, 801 | 2.6 to 10.7 |
| | Makerwal/Gul lakhel | 22 | Sub-bituminous A to High Volatile Bituminous | 10,688 to 14,000 | 2.8 to 6.3 |

**Source:** *Kazmi, A. H., and Siddiqui, R. A., 1990*

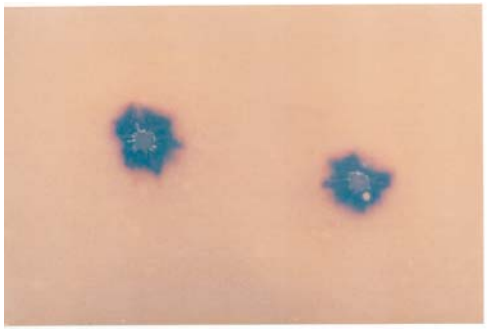


**Figure - 2: Colonies of Purified Moderately Thermophilic Iron-Oxidizing Strains**

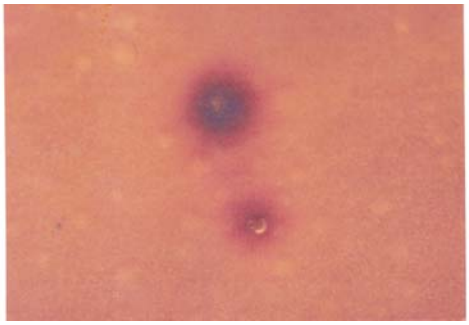


**Figure - 3: Colonies of Purified Mesophilic Iron-Oxidizing Strains**

### 2.1 Coal Samples

Coal samples were collected from Lakhra (Sindh) coal mines of Pakistan. The sulphur profile of the various coal-field has been charted in Table-1.

### 2.2 Bacterial Cultures

Mesophilic and moderately thermophilic bacteria were isolated from coal-mining sites and other extreme habitats of Pakistan. These isolates were identified as strains of *Acidithiobacillus ferrooxidans* (*HC-AF1, HC-AF2, MC-AF1, MC-AF* and *KC-AF1*), *Acidithiobacillus thiooxidans (HC-AT1, KC-AT1* and *KC-AT2*) and *Sulfobacillus thermosulfidooxidans* (*LC-MTH and MT-13*), on the basis of cultural characteristics and 16S rDNA analyses (Figure 2 & 3).

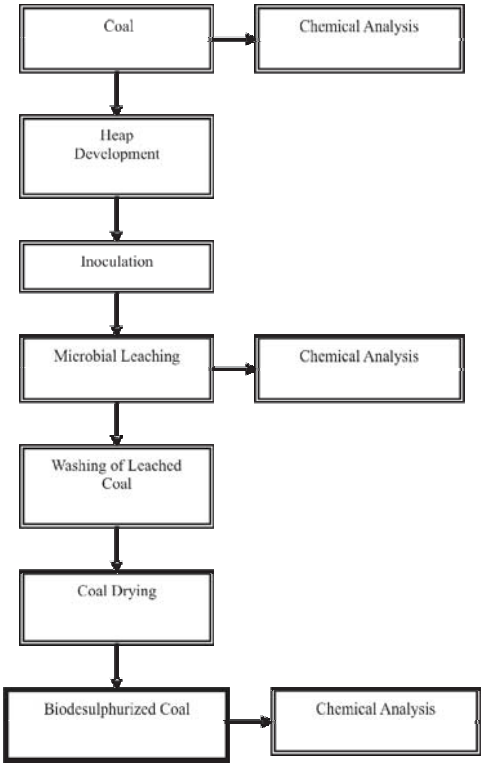



**Figure - 4: Concept Outline for Heap Biodesulphurization**

## 3. COAL BIODESULPHURIZATION THROUGH HEAP LEACHING – A PROTOTYPE

The heap leaching, as applied to the low-grade copper and gold ores, has convinced the researchers to employ this particular type of leaching process for microbial desulphurization of coal. A concept outline for heap biodesulphurization of coal is given in Figure-4. The process of coal biodesulphurization was scaled up, after successful practice runs at laboratory scale. A

prototype of 300 tons coal heap was set up with a local cement industry for coal biodesulphurization at larger scale.

### 3.1 Construction of Coal Heap

A 300-tonne coal heap, with dimensions 22 m x 4 m x 3m (L x W x H), was constructed under a shed. Perforated polyvinyl chloride (PVC) pipes of 5.0 cm diameter were laid horizontally in three tiers at equal distances inside the heap during loading the coal. These pipes served the purpose of aeration and heat exchange. Temperature sensors, along with their circuit and display system, were fabricated in our electronics laboratory. The sensor probes were inserted 10 cm, 1.5 m and 3.0 m deep inside the heap, to measure the temperature (Figure-5). A small pond (1.5 m x 1.0 m x 1.0 m) constructed in front of heap served as a sludge-pond that restrained the solid particles from entering into the main collection-pond alongwith effluent water coming out from the heap. The sludge pond was connected to the main collection pond, which had 4,000 litres of water capacity. Polyvinyl chloride (PVC) pipes (diameter 5 cm) were connected to fabricated rectangular frames that were hung overhead from the ceiling of the shed over the heap. Plastic showers were connected to the PVC pipes at equal distance (1 m) in four rows over the heap. A pump (2 hp) was used for circulating water through the heap.

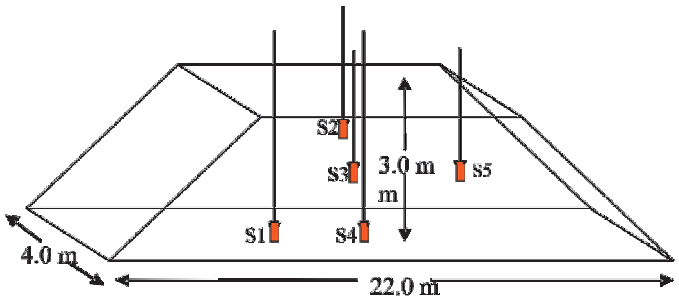



**Figure - 5: Schematic Diagram of Coal Heap Established for Biodesulphurization. Heap Dimensions and Location of Temperature Sensors (S1, S2, S3, S4 & S5) inside the Heap**

### 3.2 Process Execution

The inoculum concentrate (600 litres) containing a mixed consortium of acidophilic chemolithotrophic bacteria was added to ordinary groundwater in the main collection pond. For growth initiation, $MgSO_4.7H_2O$ and $(NH_4)_2SO_4$ were added to the pond at final concentrations of nearly one fourth of that in the basal salt-solution mentioned above. This solution was circulated through the heap with the help of a water pump. The route of the water was: collection pond→water pump→sprinklers→heap→sludge pond→collection pond. Liquid and solid core samples were taken periodically from the heap, for monitoring pH, microbial population and sulphur determination. Total

sulphur content of the samples was determined by analysis on Elemental Analyzer (Perkin Elmer, USA) in CHNS mode. Nearly 70% of total sulphur was removed in 36 days of leaching of 300-tonnes coal heap.

## 4. COAL BIODESULPHURIZATION AND ITS ROLE IN EMPLOYMENT-GENERATION

The installations/development of coal heaps for desulphurization at major coal-fields of Pakistan can give a boost to the local coal-industry and utilization of indigenous coal reserves. According to BP Statistical Review for the year of 2008, the production of coal in Pakistan has been 1.9 million tonnes of oil equivalent (MTOE), while the consumption is 6.7 MTOE [Prayuenyong, P., 2002]. So, 4.8 MTOE of coal is being imported from different countries, due to the high sulphur content of local coal. By applying the available technologies with indigenous expertise, the coal import bill can be reduced and ended eventually. In addition, this initiative would be helpful in reducing the unemployment. One working heap of 1,000 tonnes can employ 7 skilled persons at least (Table-2).

**Table - 2: Personnel Required Per Heap (1000 tonne)**

| Staff | Nature of Job | Number |
|---|---|---|
| Manager (Administration & Troubleshooting) | Overall administration of heap, its working, and regularizing the process | 1 |
| Lab Analyst (Chemical) | Analysis (Ultimate, Proximate and other physical parameters) of coal after and before desulphurization process, | 1 |
| Lab Analyst (Microbiological) | Preparation of microbial inoculum and monitoring of microbial profile in various locations of the heap | 1 |
| Semi Skilled Labour | For helping in troubleshooting, in case of any problem which occurs during the process | 4 |

Indigenous clean coal will find its application in power generation, metallurgical operations and cement industries. With the passage of time, advancement in the coal usage as a component in the energy mix is anticipated, which eventually may result in the growth of a local coal industry, thus enhancing employment opportunities in the country.

## 5. FUTURE PROSPECTS OF COAL BIOTECHNOLOGY

The transmutation of coal, especially lignite (Low Rank Coal), into liquid and gaseous fuels can provide an environmentally safe use for huge reserves of coal, as high-rank coals are being exploited at greater rate and soon these reserves will be depleted [World Coal Institute, 2005]. Transformation of low-rank coals, followed by the

application of biotechnology, would provide us an economic and effective way towards the better utilization of indigenous resources, with significant contribution in the production of value-added products [Yuan, H. L., et al, 2006]. Pakistan has a great deal of potential in the form of 175 billion tons of Thar lignite. Keeping in view the significance of this huge lignite reserve, coal biosolubilization and subsequent biogasification is being projected at laboratories of NIBGE for efficient utilization of this huge reserve of low-rank coal.

## 6. CONCLUSION

It would be wise to deploy the state-of-the-art technologies for development of the country, through tapping primary resources. This would help in boosting national economy and employment generation. The efficient utilization of indigenous coal-reserves will enable us to reduce the oil-import bill, which is US $ 4.0 to 4.5 billion. The microbial desulphurization has the potential to save US $ 7 per tonne with respect to hydropower and fuel gas desulphurization. Currently, imported coal is available in Pakistan at the landed cost of US $ 180 per tonne, as compared to the local with US $ 103 per tonne. Keeping in view the total landed cost of imported and local biotreated coal almost US $ 70 per tonne can be saved, which makes a handsome amount, regarding high sulphur-coal reserves of Pakistan.

In short, coal biotechnology, which is at the verge of commercial upscaling, has large potential in our country in terms of employment-generation for all levels of skills and education. It is recommended that implementation of coal-biotechnology be included in our national long-term policies, in order to boost our economy through relying on indigenous energy-resources and reduction in oil and coal import-bills of Pakistan.

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# SCOPE OF HEALTH-BIOTECHNOLOGY IN PAKISTAN, WITH REFERENCE TO EMPLOYMENT OPPORTUNITIES

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**ABSTRACT**

*Biosciences play a key role in the economic development of a country. The present day biosciences have an immense potential to bring together basic research innovations with new market- opportunities. Today, biotechnology is the most research-intensive industry in the world.*

*The corporate sector in biotechnology has expanded as a result of advancements made in human, plant, and animal biosciences. Biotechnology has successfully developed more than 200 new therapies, including vaccines. Moreover, around 400 biotech drug-products are currently undergoing clinical tests, to examine their effectiveness in targeting more than 200 diseases. In fact, biotechnology has contributed to the creation of hundreds of medical diagnostic tests that protect against the spread of diseases like HIV Aids and Hepatitis B&C, through blood transfusion, and help in the early detection of many serious conditions.*

## 1. INTRODUCTION

During the current decade, the global biotechnology industry has witnessed a rapid double-digit growth. This highly concentrated industry is controlled by two major markets, i.e., North America and Europe. Both together comprise 97 per cent of the total revenue generated by the industry. Asian and Asia Pacific countries, principally Australia, India and China, are the key emerging countries of these dominant markets.

Applications of biotechnology can be grouped in four broad industrial areas of: healthcare (medical), crop production and agriculture, non-food (industrial) uses of crops and other products (e.g. biodegradable plastics, vegetable oil, bio fuels), and ecological uses. Further sub-applications are also possible.

- Health Care – Curative, Preventive & Diagnostic
- Agriculture
  - Plant - Crops
  - Animal

- Industrial processes
- Environment
- Forestry
- Food and beverage processing

Review of the most recent published data f*rom: OECD (Biotechnology statistics database, January 2009)* from both developed as well as developing countries, makes it evident that in most of these countries, health biotechnology companies dominate the market. This domination is in all the three parameters, i.e., number of companies, number of employees and share of sales.

In a developing Asian country like Korea, there has been a marked increase in the total number of biotech companies from 516 in 2002 to 773 in 2006 (Table-1). The health biotech companies increased from 154 to 241 during the same period. Pakistan's neighbouring country, India, has over 150 biotechnology companies, which not only cater for domestic market, but have export earnings also. The sub-fields of health biotechnology include drugs, vaccines, diagnostics, gene therapy and monoclonal antibodies.

**Table-1: Number of Biotechnology Firms in Korea by Application**

| Field/ Year | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|---|
| **Health** | 154 | 178 | 179 | 220 | **241** |
| **Agriculture** | 48 | 16 | 21 | 23 | **25** |
| **Food and beverage processing** | 112 | 146 | 157 | 151 | **187** |
| **Natural resources** | 0 | 0 | 0 | 0 | **0** |
| **Environment** | 63 | 74 | 87 | 98 | **100** |
| **Industrial processing** | 29 | 47 | 49 | 47 | **51** |
| **Bioinformatics** | 33 | 30 | 33 | 42 | **42** |
| **Other** | 77 | 81 | 94 | 106 | **118** |
| **Total biotech firms** | **516** | **572** | **620** | **685** | **773** |

## 2. MODERN BIOTECHNOLOGY

Modern biotechnology is often associated with the use of genetically altered microorganisms, such as *E. coli* or yeast for the production of substances like synthetic insulin or antibiotics. It can also refer to transgenic animals or transgenic plants, such as Bt. corn. Genetically changed mammalian cells, such as Chinese Hamster Ovary (CHO) cells, are also used to produce certain pharmaceuticals.

Biotechnology is also commonly associated with landmark breakthroughs in new medical therapies for the treatment of hepatitis B, hepatitis C, different types of cancers, arthritis, haemophilia, bone fractures, multiple sclerosis, and cardiovascular disorders. The biotechnology industry has also been instrumental in developing molecular diagnostic devices than can be used to classify the target patient-population

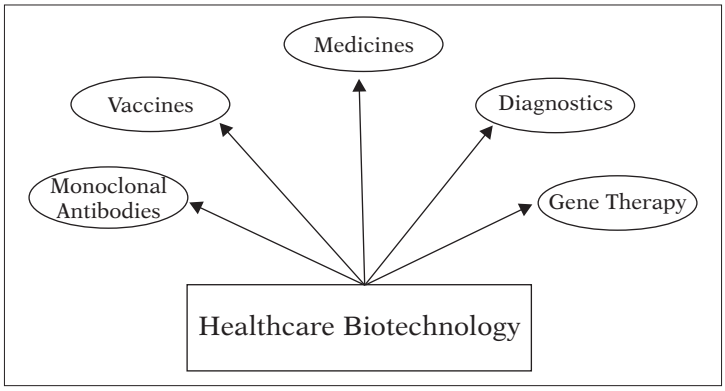


**Figure - 1: Applications of Biotechnology in Healthcare**

for a given biopharmaceutical.

Biopharmaceuticals are large biological molecules (including proteins) that target the underlying mechanisms and pathways of a disease (but not always, as is the case with the use of insulin to treat type-1 diabetes mellitus,). They can deal with targets in human beings that may not be accessible with usual medicines. Biopharmaceuticals is a relatively young industry. Small molecules are manufactured chemically, but larger molecules are created by living cells, such as those found in the human body. A few applications of biotechnology in healthcare are shown in Figure-1.

Some of the examples of Biopharmaceuticals are:

- Synthetic Humanized Insulin;
- Human Growth Hormone;
- Clotting Factors for Hemophiliacs;
- Fertility Drugs;
- Erythropoietin;
- Interferons;
- Monoclonal Antibodies;
- Vaccines; and
- Other Drugs.

Development of new biopharmaceuticals is a long term, high-risk process spanning more than ten years, from the earliest stage of drug discovery till the final stage of approval (Figure-2).

The pharmaceutical market in Pakistan is worth 105 billion rupees or 1.5 billion dollars, with a compound annual growth rate of 13% for the last 4 years. There are over 600 companies doing the business of pharmaceuticals. Multinationals are only about 30 in number and the rest are national companies (Source: IMS MAT 2008: Q4).

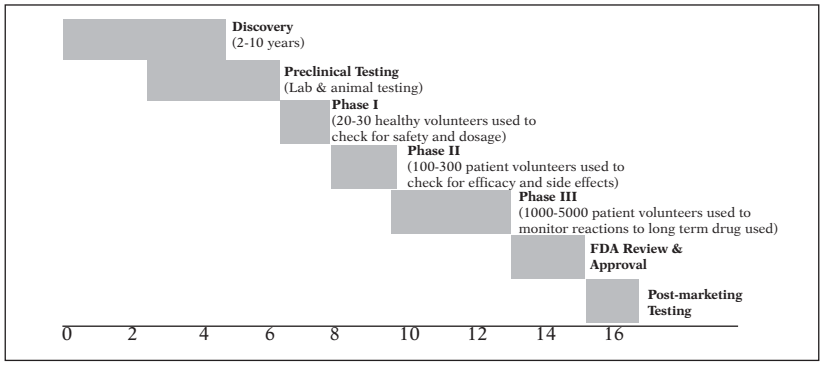


**Figure - 2: Biotech Drug Discovery Process**

## 3. HEALTH-BIOTECHNOLOGY IN PAKISTAN

Out of 105 billion rupees, the share of biopharmaceuticals is only 5 billion or 5% approximately. And only around 50 companies are importing & marketing biopharmaceutical products. On the other hand, Indian biopharmaceutical market is worth 2.5 billion dollars, catering for domestic as well as export market.

The market of Interferon, which is used for the treatment of Hepatitis B & C and some types of cancers, is 2.3 billion rupees or half of the biopharmaceutical market. This figure does not include the National Hepatitis Programme and institutional sales. All of this is imported. Interferon has been developed locally by one of the reputed research institutes and is ready for commercialization.

Insulin is another example, which has a market of around 1.2 billion rupees. Almost all of it is imported. Local production of Interferon and Insulin can save a lot of foreign exchange and, at the same time, provide employment opportunities.

Vaccines form an important segment of biopharmaceuticals. Local production of vaccines, both human and animal, is an important issue for Pakistan. Especially, when there is always a threat of biological war or terrorists using biological weapons.

There is no authentic data available for the number of jobs in pharmaceutical industry, but a rough estimate can be made. In Pakistan there are over 600 pharmaceutical companies, out of which approximately 400 have manufacturing facilities. These 400 manufacturing companies employ over 160,000 technical and professional people, including pharmacists, microbiologists, biochemists and other science graduates. Around 50 companies deal with imported biopharmaceutical products, but only one national company has set up finishing and formulation facility for vaccines and, very recently, a therapeutic proteins facility has been inaugurated by the Prime Minister of Pakistan. The health biotechnology is in its infancy in Pakistan and there is a huge potential in this field, with plenty of forthcoming employment-opportunities, broken

down as below:

- Administrative (10-15%)
  - HR
  - Finance
- Production (30-40%)
  - Pharmacists
  - Microbiologists
  - Biochemists
  - General
- Sales & Marketing (50 %)

## 4. SWOT ANALYSIS OF PAKISTAN'S HEALTH BIOTECHNOLOGY

*Strengths*
- Trained manpower and knowledge base
- Good network of research institutes
- Well-developed base industries, e.g., pharmaceuticals

*Weaknesses*
- Missing link between research and commercialization
- Lack of venture capital
- Insignificant R&D expenditure by industry
- Lack of innovative R&D culture
- Poor international image of Pakistani industry

*Opportunities*
- Local market
- Export potential
- Contract research
- Increasing number of patients

*Threats*
- Heavy investment by other developing countries, like China & India
- Lack of policies relating to Intellectual Property Rights (IPR)
- Inadequate regulatory framework

In the developed countries, industry's relationship with academia is nothing new. Companies used to provide grants to universities so that their researchers could continue pushing the boundaries of innovative science. The variety and scope of relationships have since grown significantly. Generally there are seven categories in which industry-academia collaborations may fall, but examples of three most widely used categories are given in Table-2.

**Table - 2: Most-Widely Used Categories of Industry-Academia Collaborations**

| Model | Notes | Advantages | Disadvantages |
|---|---|---|---|
| **Principal investigator** | Company establishes relationship with single principal investigator to research specific problem | Principal investigator has access to company resources | Substantial management time and resource consumed as number and variety of collaborations grow |
| **One company / One university** | Company selects university with several principal investigators to work on a problem | Single large collaboration easier to coordinate than many smaller projects | Assumption that university has necessary expertise |
| **Fee for service** | Company defines problem and solution; contracts out work to one or more universities | Saves money Cross pollination of ideas across departments | Researchers feel like temporary workers rather than partners. Defined challenge limits value university can provide |

## 5. RECOMMENDATIONS

Some of the important steps to be taken for establishing new ventures that can generate employment opportunities may include:

- Adequate market and feasibility study;
- Identification of development work to make a project commercially viable;
- Optimal size of the project;
- Skilled staff, modern equipment and other infrastructure;
- Timescale for implementation of the project; and
- Tie-ups with well established research institutes.

# FOOD INDUSTRY: EMPLOYMENT THROUGH TECHNOLOGY

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**ABSTRACT**

*Pakistan is primarily an agricultural economy, with a tremendous potential for agro-based industries. Food industry is a case in point, as it depends largely on the natural agricultural products. This industry in Pakistan has yet to come of age. Most of the potential still remains untapped - other than the basic raw materials, huge amounts of ingredients are imported as these are not produced locally because of technological and /or investment-related issues. Apart from certain basic raw materials, there is a total absence of additives (natural/synthetic) that include preservatives, coloring materials, leavening agents, flavouring agents, emulsifiers, stabilizers, enzymes, etc. This paper deals with these gaps and gives proposals for new investment opportunities in this sector.*

## 1. INTRODUCTION

Food preparation and processing have been undergoing many changes in recent years, since both the food industry and the average consumer have become more sophisticated in their knowledge and approach to food. Economic and political factors have further influenced food production and consumption; not only is food complex in its chemical composition and physical structure, but it has also become complex in its economic, social, political, and emotional impact on human population. Being an agriculture-based country with a population of over 180 million, Pakistan is an ideal platform for companies seeking to expand their businesses in the global food and beverage processing sector. The food-industry in the country has developed into a multi-billion dollar industry over the last fifty years.

It is difficult to cover the whole spectrum of Pakistan's food industry but it can be put in the following broad categories, though they may not be exhaustive:

- Beverages;
- Confectionery;
- Cereal & pasta;
- Bread;
- Milk and dairy products;
- Oil and ghee;
- Frozen food;

- Spices and spice mixes;
- Ready-to-eat food;
- Ready-to-cook products;
- Biscuits and cakes;
- Jams, jellies and marmalades, and pickles;
- Seasonings and sauces;
- Food supplements;
- Neutraceutical/ functional foods.

## 2. THE PREMISE

Before identifying employment and value-addition potential of the food industry, we have to define the foundations and premise on which to build our logical superstructure for the future of this sector of Pakistan's economy. The following pointers may be considered in this regard:

a. Pakistan's economy depends largely on its agriculture sector.
b. There is a tremendous potential for growth and value-addition, through use of appropriate technology.
c. Most of the manufacturing plants in this sector are small-to-medium scale.
d. In the export market, the focus is still on traditional items, with little value-addition e.g., export of rice.
e. Changing lifestyles offer a growth-rate of over 20 % per annum.
f. The industry can provide employment-opportunities to a variety of professionals, e.g., scientists, food technologists, engineers, business managers.
g. Other than direct employment, the supply-chain can absorb many more indirectly.
h. At the farm-level, the food industry can alleviate poverty in the rural areas.

## 3. MATERIAL INPUTS

Like any other industry, the food industry needs a number of input raw materials. In this case, the inputs are primarily natural products of vegetable or animal origin, but that does not mean that these are the only items needed. In fact, in some cases mineral and synthetic materials may outnumber the natural raw materials.

### 3.1 Natural Raw Materials

- Fresh fruits and vegetables;
- Dried fruits and nuts;
- Milk and dairy products;
- Cereals;
- Meat, fish and poultry;
- Spices and condiments;

- Herbs and herbal extracts;
- Vegetable oil; and
- Salt.

### 3.2 Synthetics and Semi-Synthetics

It may be noted that natural raw materials are limited as far as the categories are concerned. However, there are many more items consumed by the food industry that may also be available in more abundance than the natural materials; a few being the following:

- Coloring materials;
- Flavorings;
- Preservatives;
- Stabilizers;
- Emulsifiers;
- Dispersing agents;
- Leavening agents;
- Enzymes;
- Anti-caking agents;
- Acidifiers;
- Anti oxidants;
- Volume extenders;
- Gelling agents;
- Gum bases;
- Tenderizers; and
- Taste enhancers.

### 3.3 Imported Materials

Unfortunately, none of these are manufactured in the country. This leaves a huge gap between demand and supply. The list of such items imported into the country runs in thousands, but just to let the readers have an idea, only a few are listed here. A comprehensive list can be prepared from the data compiled by the Federal Bureau of Revenue (FBR) (Customs).

- Monosodium Glutamate (MSG) - Taste Enhancer;
- Citric Acid;
- Malic Acid;
- Acetic Acid;
- Potassium Citrate;
- Sodium Citrate;
- Modified Starch;
- Gelatine;
- Xanthan Gum;
- Tapioca Gum;
- Gum Arabic;
- Maltose;
- Maltodextrin;
- Maltodextrin;
- Paprika (Natural color from Chilli);
- Curcumin (Natural color from Turmeric);
- Yeast Extract ( Flavor Enhancer);
- Sorbitol (Sweetener);
- Carboxy Methyl Cellulose (Thickener);
- Beta Carotene (Natural Color From Carrots);
- Chicken Flavor, Beef Flavor, etc;
- Papain (Proteolytic Enzyme From Papaya Fruit);
- Bromelain (Proteolytic Enzyme from Pineapple);
- Modified Starches.

This short list does not include the prepared food items imported into the country on a regular basis.

Special attention is thus required in the following specialized sectors:

- High Value-Added Items;
- Organic Food;
- Meat and Poultry;
- Ready-to-eat Items; and
- Ready-to-cook Items.

Covering the short-fall of these items provides opportunities for direct and indirect employment of professionals, skilled technicians and labour. Some specific items have been described as follows:

### *3.3.1 Monosodium Glutamate*

Most people know it as Ajino-Moto or Chinese Salt. A white crystalline powder, used widely in a variety of dishes and seasonings as a taste enhancer – particularly in Chinese cuisine and snacks. The prevalent method of manufacture is by the microbial fermentation of molasses. This raw material is abundantly available in Pakistan as a byproduct in sugar mills.

### *3.3.2 Curcumin – Natural Yellow Food-Color*

Curcumin is a bright yellow natural colouring material, which is extracted from Turmeric. The process involves extraction of the pigment from powdered turmeric by solvent-extraction method, using organic solvents. More sophisticated method employs super-critical carbon dioxide, which ensures that there is no residual solvent in the extract. There is a growing resistance in Europe and the US towards the use of artificial colouring material in food. The obvious safe alternatives are natural colours. In the absence of an indigenous production capability, the use of imported natural colours will become prohibitive, directly affecting our competitiveness in the export markets, with a consequent effect on employment .

### *3.3.3 Paprika Oleoresin Extracts - Natural Red Food Color*

Paprika Oleoresin extracts are used as a bright red natural coloring material for food applications and are extracted from the oleoresin of red chilli. Like curcumin, the preferred method for preparation of this additive is solvent-extraction method. This red pigment can be used to replace the synthetic food-color effectively. Raw material is plentiful in Pakistan, especially in the province of Sindh, where Kunri is famous for its Dundi Cut variety.

### *3.3.4 Citric Acid*

Citric acid is used in nearly all the carbonated drinks, and is an essential ingredient in jams, jellies, marmalades, ketchups and sauces. Originating as a byproduct of

food and vegetable processing industry, this valuable acid can be obtained by fermentation techniques, using a special strain of "Aspergillus Niger."

These are just a few examples of the possible opportunities in the food and related sectors, which rely specifically on indigenous raw materials.

Apart from the industry, a sustainable development in the food-sector needs special attention and investment for the following:

- Cold storages;
- Controlled environment warehousing;
- Sterilization and sanitization;
- Packaging development; and
- Laboratories, testing and certification facilities.

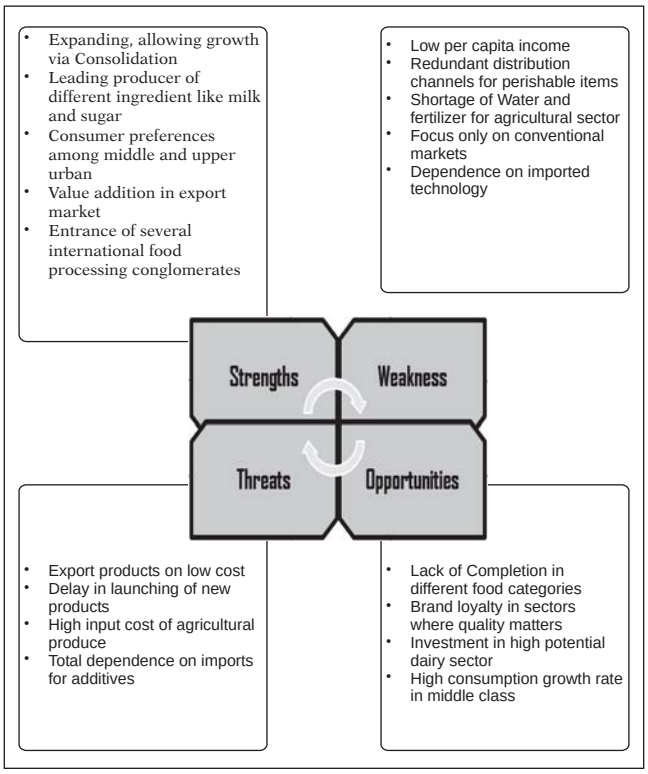


**Figure - 1: SWOT Analysis**

## 4. NEEDS AND REQUIREMENTS

Efforts to develop technical solutions will not be fruitful unless supported by an

enabling environment whose essential components should be:

- Safety and security;
- Supportive policies;
- Financial incentives;
- Minimal interference;
- Good governance and political stability; and
- Confidence-building measures.

## 5. RECOMMENDATIONS

A strategic action-plan for development of food-industry and its employment-potential can be developed by:

- Gap/SWOT analysis, to identify requirement, local production-capability and capacity;
- Involving academia and research organizations for indigenous development;
- Assessing employment-potential of various units;
- Facilitating local/foreign partnership;
- Selecting feasible high value-addition technologies that support employment;
- Identifying all stakeholders;
- Involving stakeholders at an early stage;
- Providing infrastructure;
- Developing and promoting the cluster-concept location of industrial units in groups near the source of raw materials; and
- Reinforcing confidence-building measures for the entrepreneurs.

## 6. CONCLUSION

Being an agriculture-based country with a population of over 180 million, Pakistan is an ideal platform for companies seeking to expand their businesses in the global food and beverage processing sector. A proper implementation/investment strategy, if adopted, will open the way for new avenues in sustainable development, greatly enhance the employment-opportunities for scientists, technologists, engineers and other professionals.

# WEALTH GENERATION THROUGH RESEARCH: A CASE STUDY

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**ABSTRACT**

*Pakistan, a country with over 180 million population and an area of 796,095 square kilometers, is blessed with abundant natural resources: a unique country where altitudinal difference from 0 m (coastal area) to 8,611 m (K2) creates rich floral diversity of over 6,000 plant species. The region Northern Areas of Pakistan has unique importance because of its diverse bio-physical environment and an extremely rich cultural milieu of its inhabitants belonging to hundreds of ethnic groups and indigenous communities. The herbal medicine is of socio-economic and religious significance; an advanced centre for research on toxicology and herbals existed in Taxila more than two thousand years ago. They are not only of value for the cultures from which they evolve, but also for scientists and planners striving to improve conditions in rural societies. For sustainable development of the Himalayan region, application of the indigenous knowledge of mountain people, in relation to biodiversity resource-management is one of the key issues.*

*There is a need to educate and organize communities of the region for conservation of species, followed by capacity building and linkages with the market or institution involved in the business, in order to sustainably follow the agenda of conservation of plant species. A conservative approach indicates that at least 700 plant species are being used as medicinal and aromatic plants. Besides, there are several reported wild plants that are used as primary food and some are used as condiments. There are an estimated 800 species or more that may give a cure for certain diseases (Shinwari et al., 1996).*

*Advances in technology, meanwhile, show us that the most "insignificant" or even "disgusting" of creatures can prove priceless to medicine, agriculture or industry. For instance, a slimy marine worm might yield chemical compounds with potent healing properties, or a previously overlooked microbe may turn out to have the ability to neutralize a toxic waste. Accordingly, this paper gives the case-study of a local herbal pharmaceutical company, based in Karachi.*

*From humble beginning in 1968, Qarshi Industries (Pvt) Ltd. is now Pakistan's largest herbal pharmaceutical company that has 6 International Certifications/Accreditations. Qarshi has more than 200 products in the market in natural medicines, refreshing syrups, food and farm products & health supplements. Qarshi's products are result of*

*good standard material, i.e., organically grown, genetically verified and standardized.*

## 1. INTRODUCTION & BACKGROUND

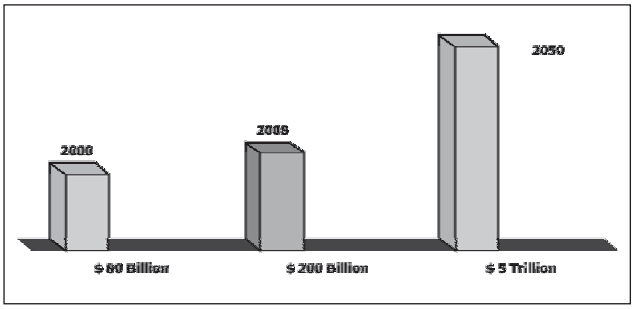
Medicinal plants are important for the livelihoods of the poor communities all over the world. There are about 258,650 species of higher-altitude plants, of which more than 10 per cent are used medicinally. The global market (2002) for medicinal and aromatic plants was US$ 62 billion and estimates suggest that it will reach US$ 5 trillion by 2050 (Journal of Ethnobiology and Ethnomedicine 2006, 2:32) (Figure-1).

Pakistan has more than 6,000 species of higher-altitude plants (Ali and Qaiser, 1986). At least 12% of the flora is used medicinally and several plants are exported. There is a huge crude drug market [Pansara market] system that is almost entirely dependent on wild-plant species (Khan, 1985). Both human and animal ailments are treated through the use of medicinal herbs. In most instances, certain plant species are considered specially useful to treat a particular illness but, occasionally, they have mixed usage. Women, followed by children, are identified as the principal collectors of medicinal plants. Due to over-collection, several species have gone extinct in the Hindukush-Himalayan regions (Saxena et al., 2001; Shinwari et al., 2002) .

Local collectors, vendors, herbal drug dealers and others threaten the flora of Pakistan, as they contribute (though unknowingly) to the extinction of some and bringing others to the brink of extinction (Shinwari and Khan, 2001).

Some of the limitations of modern healthcare systems are that the knowledge derived from Western invention is based on high-cost technology and is challenged with the frequent emergence of drug-resistance and side effects. Developing new drugs entails huge investments and long durations. Modern drugs also bring with them the risk of environmental contamination, toxicity and drug residues.

There is a need to provide basic knowledge and training to professionals on various aspects of ethno-medicine, ethno-pharmacology and ethno-botany. There is also a




**Source:** *Journal of Ethnobiology and Ethnomedicine 2006, 2:32 )*

**Figure - 1: Trends of Use of Medicinal and Aromatic Plants in Global Market**

need to establish a central apex-body to guide research needs, regulate quality-standards and registration-procedures for herbal drugs (Aumeeruddy et al, 1998; Aumeeruddy, Y., And Pei, S., 2003).

There is, therefore, a need to find ways to harvest medicinal plants sustainably from the wild; train local collectors (in proper collection-techniques); train the people in growing medicinal plants; and remove some of the middlemen from the trading chain. Major reasons for the loss of biodiversity are that most people live below the poverty line, and harvest natural resources mindlessly to subsidize their incomes. More than half of the collected material is thus lost, before reaching the consumer (Hamilton et al., 2003).

## 2. QARSHI INDUSTRIES (A CASE STUDY)

From a humble beginning in 1968, Qarshi Industries (Pvt) Ltd. is now Pakistan's largest herbal pharmaceutical company with multiple international certifications and accreditations {*ISO 9001 – Quality Management Systems, ISO 14001 – Environment Management Systems, HACCP – Product Safety Systems, ISO 17025 (Norwegian Accreditation) International Accreditation for Quality Testing, ISO 17025 (PNAC) National Accreditation for Quality Testing, Organic Certification – Chemical & Pesticides Free Cultivation*}.

*Today Qarshi has four independent companies from Business (Qarshi Industries & Dawakhana) to welfare (Qarshi Foundation, Health, Education, Environment & Employment) and research (Qarshi R & D and Qarshi Research International).* The major Qarshi companies are shown in Figure-2.

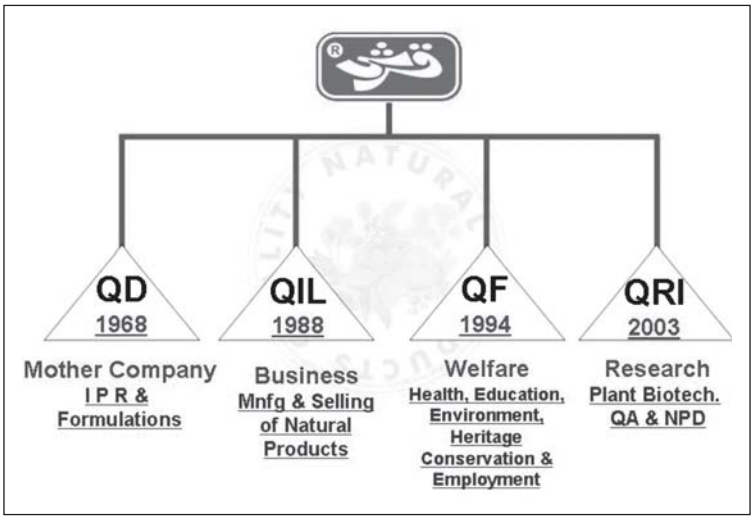



**Figure - 2: Main Units of Qarshi Industries (Pvt) Ltd.**

It was conceptualized 75 years ago by the venerated poet of the East, Allama Muhammad Iqbal. Its inception was in the shape of a clinic opened by Shifa-ul-Mulk Hakim Muhammad Hassan Qarshi. In 1968, the youngest son of Shifa-ul-Mulk, Mr. Iqbal Ahmed Qarshi (CEO Qarshi Industries), after completing his M.Sc in Chemical Engineering, laid the foundation of Qarshi Dawakhana, which has now developed into Qarshi Industries, a modern and successful company that outweighs by far the expectation of its original founder.

The plant of Qarshi Industries is equipped with machinery from USA, Germany, Italy, China and Korea. Major expansion and improvement programmes in the manufacturing facility are being carried out since 1998, to meet the increasing demand of the company's products in both national and international markets.

The process of discovering a new herbal product is a long and arduous process of investigations (Figure-3).

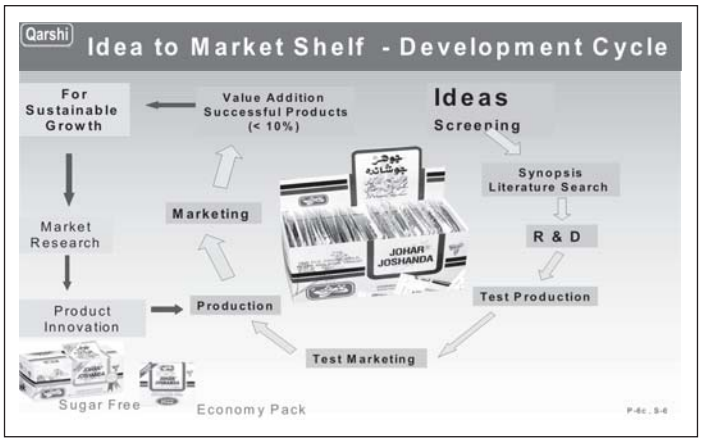



**Figure - 3: Product Development Cycle – From Idea to a Product**

In 1980, Qarshi was the first herbal pharmaceutical company to set up a system for research and development, on modern lines, for the therapeutic values of herbs and plants. Their qualified and highly skilled staff is completely aware of recent developments in herbal manufacturing technology of pharmaceuticals. The use of modern technology has resulted in high-quality products, which are at par with the international standards, thus assuring the highest standard of quality. The aim is to become leaders in herbal medicines, traditional juices (sharbats) and natural supplements, with focus on products that enhance the quality of life.

Qarshi Industries is playing its due role as a responsible corporate entity, by being an environment-friendly company. Effluent water discharge from the premises is free from any toxic element. The beautiful landscape of the factory, with its herbal and fruit garden, is true reflection of the motto of "Whatever we set out to do, is done in an

exemplary manner".

Under the guidance and direct supervision of Mr. Iqbal Ahmad Qarshi, more than two hundred products have been developed based on indigenous knowledge of "Ayurveda" and "Tibb-e-Islami" and experience gained over the years. The mega-brands of Qarshi Industries are: Qarshi Johar Joshanda, Surficol tablet & liquid, Gestofil tablet & liquid, etc.

## 3. DISCUSSIONS & RECOMMENDATIONS

i. To initiate conservation-based activities, various strengths and weaknesses need to be identified. For example, major problems in one of the study areas (Kurram Valley) were poverty, lack of awareness of alternatives, lack of skills, lack of marketing-opportunity, expanding human and animal population, absence of any working-institution, etc. Strengths were recognized as organized communities, common and equal rights [egalitarian society], absence of major disputes, functional social institutions, uniform social and economic status, great diversity in climate and topography, rich natural resources and community willingness.

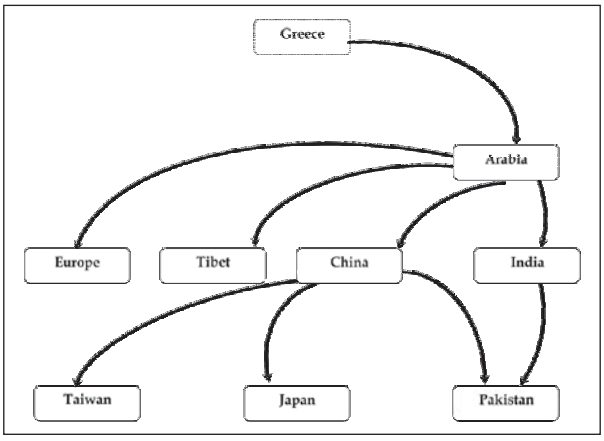



**Figure - 4: Trade Chain of Medicinal Plants, Showing its Possible Origin from Greece (Shinwari et al., 2000).**

### ii. Future Lines of Action May Have the Following Components:

- Awareness-raising;
- Institutionalization of community organizations;
- Forest-product based activities: The poorer households usually depend on forests for a larger share of their overall livelihood needs. Forest-products based activities can be particularly important to women, because many such activities can be combined with their household tasks. Ease of access to the resource and requirement of low skill and capital- thresholds to commercial

forest-product activities mean that these can be very important in addressing the needs of the poor;

- Joint collaboration for future projects of different NGOs, government agencies, etc;
- Development of linkages among different stakeholders;
- Capacity building activities;
- Ethnobotany Programme;
- Holistic National Resource Management (NRM) Programme, for example, to identify key mutualisms for management, as:
  - Pollinators, including insects, birds, bats, certain arboreal mammals, such as opossums, even a few lizards;
  - Seed dispersers, including mammals, birds, ants, and fish that transport, drop or ingest fruits and their seeds, thereby facilitating the establishment of new populations;
  - Over-storey plants, such as nurse trees that are critical for providing suitable microhabitats for seed-germination, growth of seedlings and protection from trampling or consumption by herbivores;
  - Microbial symbionts, such as mycorrhizae and nitrogen-fixing bacteria that enhance plant-growth through nutrient uptake; and
  - Organisms that provide defence for a plant, such as ants that protect a plant's foliage and fruit from herbivores and seed predators.

Some of the important factors that will contribute to communities' sustainable livelihoods include: provision of opportunities to participate in decentralized resource-management; a willingness to try to better understand the complex environment of communities; to respect and incorporate traditional knowledge into resource-management plans; ensuring communities' access to technological innovations and/or opportunities for them to develop forest-management practices and technologies based on their self-felt needs.

There is a lot of potential of benefitting from cultivation. Take the example of Crocus sativus (Saffron):

- Aromatic and flavouring agent in spices;
- Sacred plant, used to make ink to write holy verses of the Holy Qur'an;
- Cooler climate;
- 70,000 to 200,000 flowers yield 1 kg dried saffron threads;
- Growing 50 corms/$m^2$ may yield 80 to 400 flowers in two years;
- One acre land may yield profit of more than Rs.1,00,000;
- Qarshi Industries consumed 60 kg in 2002 (Rs. 30,000 per kg) in herb-based preparations.

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**Glimpses of the Technical Sessions of the Seminar**


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# Information and Communication Technologies (ICTs)

# SELF-EMPLOYMENT IN ICT: ISSUES AND OPPORTUNITIES

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**ABSTRACT**

*This paper reviews the significant impact of Information and Communication Technologies (ICT) in areas of education, training and employment. Diverse strategies have been discussed that prove the potential of ICT in developing youth entrepreneurship, promoting public-private partnerships, bridging the gap between the digital economy and the informal sector. We have also developed self-employment models and summarized how these models would bring up more employment opportunities in Pakistan, without putting undue burden on the Government.*

**Keywords:** Self-Employment, Careers in Information and Communication Technology, Entrepreneurship.

## 1. INTRODUCTION

Advances in Information and Communication Technology (ICT) have changed the way we teach, learn and earn. The most exciting aspect of this new technology is its potential to create wealth and to cut down the unemployment ratio in the developing countries, like Pakistan. One use of ICT is to provide on-line services for job-placement through electronic labour exchanges in public employment service or other placement agencies [Yigitcanlar, T., and Baum, S., 2008]. Normally, job-brokering is carried out as a closed system, involving intermediaries on behalf of their clients [Shah, N. Z., 2008]. There are diverse sources to legitimate work, and/or grant access to a huge database of various jobs/work available. Many freelancing jobs are in remote administrative support, project-management assistance, and so on. Often they do not require any special education. Guru and Elance, and Facebook are very reputable freelancing services, to name just a few [Mary, S., 2009].

## 2. MOTIVATION

Creation of new types of systems and organizations can create markets and jobs in many ways. Promoting youth employment and youth employability, to spread awareness for the availability of a number of tested methods underlines the fact that

effective and proven policy-measures can be formulated to meet the employment needs of every developing country, where unemployment-ratio is increasing exponentially. Most of the self-employment-opportunities usually offers the following advantages:

- The business can be operated from anywhere in the world.
- It does not require to put-up heavy initial costs, since all that is required is a computer and an internet connection.
- Gives unlimited potential to make money.
- Business runs itself 24 hours a day.
- Short-term experience or no previous experience is needed.

Importance for the growth of Information and Communication Technologies (ICTs) in self-generating employment is now a matter of broad consensus in policy-making, business and also increasingly academic economics [O'Higgins, N., 2001]. There is an extensive potential to generate employment for young ICTs graduates. Employment-generation is a product of multiple factors that combine together [Curtain, R., 2000] & [Curtain, R., 2002].

## 3. LITERATURE REVIEW

A few of the success stories appraised here are of Google, Juniper Networks, Facebook and the success secret of Bill Gates [Scott, V. A., 2008]. This paper lights the beam of hope for the unemployed-youth having ICT skills and looking for the platforms to become entrepreneurs. Furthermore, this study will underline opportunities and issues related to the range of supporting strategies and policies (in place) to be adopted and practiced in the developing countries, like Pakistan, to play a role in the race of the un-employment to self-employment.

Everyone around the world knows about Google, but what needs to be known is how it turned out to be a multimillion dollar business. Larry Page and Sergey Brin, two university students, started Google as a small university project. They hypothesized that a search- engine that analyzed the relationships between websites would produce better ranking of results than existing techniques, which ranked results according to the number of times the search-term appeared on a page. Then they realized the importance of it. They launched it commercially and it led them to both fortune and glory. Juniper Networks pioneered by Pardeep Sindhu, who worked with Xerox for 11 years and, later on, realized his skills. He initiated his own business, which provided solutions for diverse network infrastructure. Pardeep Sindhu initially faced some financial issues but, today, is one of the leading network solution providers in the world [Juniper Networks, Inc, 2009].

Facebook is the biggest social blogging network around the globe. Facebook was founded by former Harvard student, Mark Zuckerberg. The main purpose of Facebook was to connect diverse students and form alumnis, but local people found this social

networking interesting. Mark took advantage of this idea and made it commercially available to people worldwide and sold his project in 2005 to “the facebook” and is now officially known as Facebook [Markoff, J., 2007] & [Yadav, S., 2006]. Bill Gates started his Company Traf-O-Data with his best friend Allen, during his undergraduate studies. They developed a small computer to measure traffic flow. This project was such a big success that they earned around $20,000 in their first go. Later, Bill Gates was dropped out from Harvard and he formed Microsoft. The Microsoft vision was "A computer on every desk and Microsoft software on every computer". Bill Gates was and still is a pioneer of the computer-field, and achieved levels of unimaginable wealth [Lee, L., 2002]. All these examples reflect how people can be their own boss and became successful as well.

## 4. ISSUES

There are diverse issues that ICT graduates face. Fresh graduates do not have business experience, financial strength and in this situation they cannot make their own investments, despite having talent; and this is the point where talent goes underutilized. In some cases, graduates are ready to make small investments but, without having business experience, the chances of failure are higher, which can turn into frustration.

## 5. SUGGESTED APPROACHES

We have developed four diverse models (i.e. Private Sector- Graduate Partnership Model, Public-Private Employment Model, Public-Private-Graduate Partnership Model and Graduate-Graduate Partnership Model) considering different scenarios, which could assist in augmenting the employment rate in Pakistan.

### 5.1 Private Sector-Graduate Partnership Model (PSGP)

According to PSGP model (Figure-1), both the private sector and graduate make an equal investment (50:50) into the business or the project. The profit-sharing would be 30% for the Private Sector and 70% for the Graduate. This is because the work is being done by the graduate and the project is outsourced to the graduate by the Private Sector.

### 5.2 Public-Private-Graduate Employment Model (PPGE)

In this approach, the public and private sectors make an equal investment (50:50) into the business/project. However the implementation would be done by the Graduate employee. For example, public and private sectors work jointly on projects with mutual interest, but the major issue is deployment or execution of the project. In this scenario, fresh graduates who have particularly worked in that field could be hired who could implement this project and get employed as well (Figure-2).

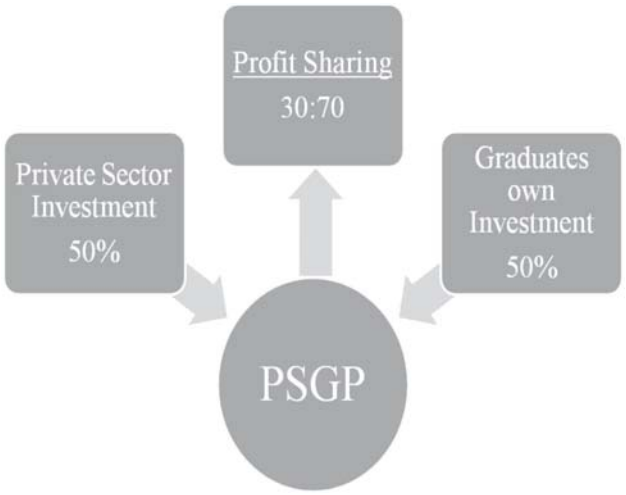


**Figure - 1: Private Sector-Graduate Partnership (PSGP) Model**

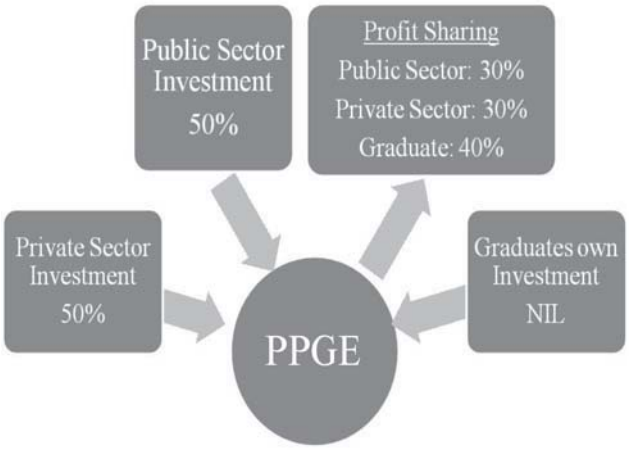


**Figure - 2: Public-Private-Graduate Employment Model**

### 5.3 Public-Private-Graduate Partnership (PPGP)

In this type of approach, Public-Private Sector and Graduate all three make investment in the business or projects. Such projects are again of mutual interest and benefit (Figure-3).

For example, the public sector wishes to extend its telecom infrastructure in a rural area, but to make its execution effective, it outsources the project to the private sector. The private sector further looks for a local graduate who is capable of deploying this

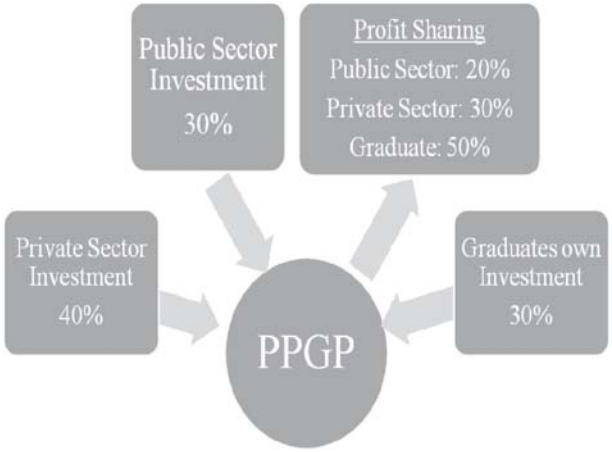


**Figure - 3: Public-Private-Graduate Partnership Model.**

project and makes an investment in this business, as well. This type of approach would benefit not only the Private and Public Sector, but the Graduate and local community as well.

### 5.4 Graduate-Graduate Partnership Model (GGP)

This approach is based on two graduates sharing investment and experience. In this case Graduate 'A' makes a 100% investment, but does not have an experience and, therefore, is not comfortable to take the business risks alone and makes a partnership with Graduate B, who has a sound market exposure and experience. Based on this approach, both of the Graduates, A and B, get employed and earn their bread and butter as well (Figure-4).

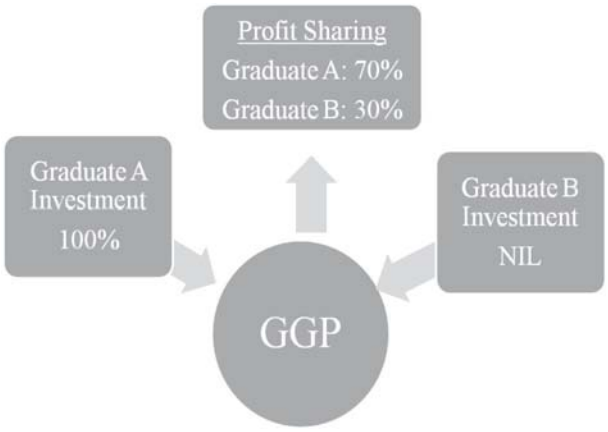


**Figure - 4: Graduate-Graduate Partnership Model**

## 6. BENEFITS

There are a lot of perquisites perks associated with being self-employed, whether it is through a career as a freelancer or starting a home-based business. These approaches would offer a wide range of benefits, like:

- Reduction in unemployment.
- To at least some degree, the self-employed persons can set their own business hours.
- Socio-economic benefits.
- Increased sense of competition.
- One's level of achievement cannot be controlled by anyone else.
- Complete recognition for one's achievements and successes.
- Generation of more economic activities.
- May result in providing small-scale ICT services at the doorstep.
- Entrepreneurs get to make the rules, rather than following someone else's.
- The self-employed do not have to worry about actually searching for a job.

## 7. OPPORTUNITIES

There are very little job opportunities in Public and Private Sectors where majority of fresh graduates do not have their own investments. If these models are further refined by policy-and decision-makers and are systematized, they would offer a platform for launching suitable new businesses or projects.

There are diverse possible businesses in ICT that freshers could venture into. For example small-scale software incubator, networking, computer composing, computer sales and repair, short-course centres, web portals, electronic sign-board, mobile repairing shops, computer games, etc.

## 8. CONCLUSION

Promoting youth employment and employability requires important integrated efforts that include actions in the areas of education, skill-development, job supply and support for young low-income entrepreneurs. There is an extensive potential for ICTs to generate employment for young people. However, this potential will be really effective when the country has a range of supporting strategies in place, including an enabling environment.

Introducing ICTs in education is the key to provide young people with ICT skills. Therefore, the government needs to run more projects for education. The participation of young people in the development and implementation of initiatives involving the use of ICTs is a must. Support for starting ICTs-related enterprises is a key-service that governments, private sector, multinationals, NGOs or international organisations could organise to provide guidance to young entrepreneurs. We have

proposed four different models viz Private Sector-Graduate Partnership Model, Public-Private Employment Model, Public-Private-Graduate Partnership Model and Graduate-Graduate Partnership Model, considering different scenarios, which could assist in augmenting the employment-rate in Pakistan without putting burden on the Government .

**ACKNOWLEDGEMENT**

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# ROLE OF PTA AS A FACILITATOR OF THE TELECOM SECTOR

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**ABSTRACT**

*In the current era of de-regulated and liberalized telecommunication sector, regulations are kept to the indispensable minimum. The role of Pakistan Telecommunication Authority (PTA) has lately been comprehensively restructured, with more emphasis on facilitating the industry and promoting an environment that encourages fair competition among the service providers and provides services to consumers at affordable tariffs.*

*Under these new liberalized telecommunication policies, the PTA has transformed institutionally from a mere watchdog into the telecommunication community facilitator to a collaborator and a facilitator.*

## 1. INTRODUCTION

The Telecommunication (Re-Organization) Act No. XVII was promulgated in 1996 that aimed to reorganize the telecom sector of Pakistan. Under Telecom Reorganization Act 1996, Pakistan Telecommunication Authority (PTA) was established in January 1997 to regulate the establishment, operation and maintenance of telecommunication systems, and the provision of telecom services.

PTA has endeavoured to serve the IT and Telecom sector of Pakistan for its growth and development, while regulating and promoting new technologies and services, introducing competitive operators on fair grounds and promoting consumers' interests. The Telecom sector of Pakistan has seen immense growth over the past few years, which has been mainly due to the flexible regulatory regime and vast promotion of new technologies and services offered by various operators.

## 2. IMPERATIVE FUNCTIONS OF PTA: AS A REGULATOR

Encompassing the fact that PTA's role as a regulator, coupled with its vision to serve as a facilitator of the Telecom Sector, PTA believes that augmentation and intensification of the telecom market is momentous, in ensuring telecommunication growth in the country and with this concentration, the expansion and acceleration of telecommunication infrastructure to extend telecommunication services to the under-

served and un-served areas has been its prime objective, *also recognized under the De-Regulation Policy of 2003*. The Pakistan Telecommunication (Re-Organization) Act, 1996 defines PTA's role as:

i. Guardian/custodian of interests of telecom sector;
ii. To promote and protect interests of users of telecom sector – s.4(1)(c);
iii. To promote high-quality, efficient, cost-effective and competitive telecom services – s.4(1)(d);
iv. Regulating competition in the telecom sector and protecting consumer rights – s.4(1)(m);
v. To investigate and adjudicate complaints quickly and expeditiously, while monitoring the industry – s.4(1)(f); and
vi. Telecom Consumer Protection Regulations 2009 – a mechanism to redress consumer grievances.

## 3. THE PTA AS A CATALYST OF CHANGE TOWARDS LIBERALIZATION AND DEREGULATION – THE DEREGULATION REGIME 2003

The deregulation regime, pioneered by PTA in 2003, premeditated to provide increased service-choice for customers of telecommunication services at competitive and affordable rates. In addition, it assisted to promote infrastructure-development, which invariably increased tele-density and the spread of telecommunication services in all market- segments (including voice, data and cellular) in Pakistan. It has also an increased private investment in the telecommunication sector and encouraged local telecom manufacturing / service industry. The PTA has been able to strike a balance between emplacing appropriate regulatory measures and facilitating growth in the sector.

Great emphasis has been laid on liberalizing the telecommunication sector. However, the presence of adequate legal structures cannot be completely displaced because some state- interventionism, albeit minimal, must coexist with a free development on the market. In this regard, PTA's role has been two-pronged:

i. To ensure open and competitive telecom market, by putting in place enhanced coordination and better cooperation among the market-agents and promoting facilitation of procedures for the ultimate users; and
ii. Strengthening the regulatory and supervisory systems, with emphasis on mutual consultation to increase transparency of processes.

## 4. COMFORT LEVEL FOR OPERATORS: PTA AS A FACILITATOR

Another very important initiative of PTA, which is worth highlighting, in order to reinforce our earlier assertion that the role of PTA is not merely to regulate and supervise the telecom sector, but also to act as a catalyst of change towards liberalization and deregulation, is to increasingly work in conjunction with the sector

service-providers. For example, before any regulation is formalized into an instrument having legal force and validity, PTA has developed a consultative process to obtain input of those to whom these regulations would apply. Therefore, recognizing its own role as a negotiator, conciliator, facilitator and discussant in the process of giving legal force to procedures and processes, PTA obtains formal input from the service-providers and other stakeholders in the industry.

This is yet another example of how PTA acts over and above a mere regulator and promotes collaboration and facilitation. Such consultations have led to a closer interaction with the industry, to understand the ever-changing technological advancements involving telecommunication. Easy accessibility of information, prompt response to queries, transparent procedures, fast processing of applications, industry support, coordination/ correspondence with international organizations, such as ITU/APT/IMO and Telecom Regulatory Bodies are some of the facilitations PTA has been ensuring.

## 5. PTA AS A CUSTODIAN OF RIGHTS AND INTERESTS

The Pakistan Telecommunication (Re-Organization) Act, 1996, in general, and the amendments inserted through the Pakistan Telecommunication (Re-Organization) (Amendment) Act, 2006, in particular, have also facilitated the role of PTA from a mere supervisory body to a guardian and custodian of rights and interests of all users of telecom. The Act recognizes, amongst many other functions, one of the most important functions of PTA to "promote and protect the interests of users of telecommunication services in Pakistan", in para (c) of sub-section (1) of section 4. Therefore, the assertion that PTA is not only a mere regulator but also functions as a custodian of rights and interests of those who use the systems and services regulated by PTA *is reinforced by these provisions*. PTA does not merely function to regulate the establishment, operation and maintenance of telecommunication systems and services, but it has been performing much more extensive functions that highlight its role as a facilitator of the telecom community. "Promoting the availability of a wide range of high quality, efficient, cost-effective and competitive telecommunication services throughout Pakistan", "promoting rapid modernization of telecommunication systems and services", as well as "protecting consumer-rights, while regulating competition in the telecommunication sector" are amongst the examples as given in paras (d), (e) and (m) of sub-section (1) of section 4 of the PTA Act, 1996, that have given PTA the mandate over and above merely being a regulator of the industry.

## 6. ACHIEVEMENTS OF PTA FOR I.T AND TELECOM SECTOR OF PAKISTAN

PTA has accomplished a substantial number of projects in the recent past; for instance, the Mobile Number Portability (MNP) was successfully launched in Pakistan, embarking it as the first country in South East to have successfully deployed the system. The system could facilitate users to retain their cellular numbers, while giving them the facility to change the operator. Similarly, the introduction of International

Mobile Equipment Identity (IMEI) has helped the Authority to block 349,033 cell phones till now.

The 7 to 8 Digit Migration Project has been deployed, keeping in view the international practices and with agreed-upon consultation of the industry. The system requires no change in existing 11-digit numbering plan, no inconvenience to existing callers and provides least inconvenience to operators, in lieu of great benefits. Another successful initiative of PTA was SIM Activation & Verification System, which prevents sale of inactive SIM and the activation of a SIM through Online Verification System. This has helped blocking of 11.2M unverified connections. Moreover, the Gray Traffic Monitoring System helps PTA in successful raids by monitoring and blocking the IP addresses.

PTA has also acted as a facilitator of the ICT-sector in Pakistan. PTA believes that the importance of ICTs lies less in the technology itself than in its ability to create greater access to information and communication in *underserved populations*. In view of the same, PTA has carried out a significant number of projects, one of which is the transition of .pk country-code top-level domain (ccTLD). The .pk DNS infrastructure has been successfully mirrored in Pakistan, encouraging the local content development and hosting. This is a historic shift towards local Internet progress. Establishment of local Internet exchange- points will not only help with cost and routing efficiency at international bandwidth; but will also ensure an invariable access to Internet locally.

PTA has also introduced an SMS-based Education Information System, which is an interactive mobile application for educational institutes. The system is a fast and easy way to disseminate important information to parents, free of cost.

PTA has also carried out comprehensive studies on Public Key Infrastructure (PKI), Dataware House, In-house Telecom Cabling, International Roaming, Socio-economic impact of Telecom Growth and Telecom Indicators Forecast, Short-Range Devices, RF Spectrum Management, ICT Security Guidelines, E-commerce Gateway for Pakistan, RFID, Unbundling of Service and Access and Services.

Another initiative of PTA is the "Mobile Commerce", which could help in the possible introduction of m-Banking and m-Ticketing services in Pakistan. This can prove to be lucrative for Pakistani environment, where huge mobile penetration can prove to be a great opportunity.

The proliferation of broadband services in Pakistan is one of the key initiatives that PTA is ardently working on. It has formulated the broadband stakeholders group (BSG), which is a unique platform for related stakeholders. The Group has released its first recommendations report. Similarly, PTA shall conduct a broadband subscribers survey, which shall focus to attain exact number of broadband users in Pakistan and would help in setting a future roadmap. PTA is also in the process of setting up

broadband quality-of- service parameters to evaluate the progress of broadband in Pakistan.

This private-sector investment in the country has also addressed the employment-problems that pervade the developing countries, especially like ours, where disproportionately large number of masses are exposed to unemployment or limited to precarious or short-term work. It is also worth-mentioning here that PTA had initiated 350 "Rabta Ghars" all over Pakistan, which not only provided self-employment to masses in un-served and underserved areas, but also acted as a facilitator of the Information Communication Technologies.

# LEVERAGING ICT IN CREATING JOBS

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**ABSTRACT**

*The pattern of economic growth should be favourable to employment-generation. It is, therefore, important that employment and manpower concerns be linked with overall economic policies, particularly relating to the development and utilization of human resources.*

*Information and Communication Technologies (ICT) play a major role in all aspects of national life: the economy, as well as in social and cultural development. It is rapidly transforming our lives, the way we do business, access information and services, communicate with each other and entertain ourselves. It fuels the global economy. It also relates to human rights, helping, at best, to support freedom of expression and the right to information.*

*It is argued that the ICT, if supported with the right policies and with cross-cutting and holistic approaches, will complement and strengthen other multi-sectoral efforts that are required for creating jobs, thus resulting in economic growth.*

## 1. INTRODUCTION

Today, Information and Communication Technologies (ICT) and wireless technologies make it possible to provide instantaneous access to knowledge and information that was not possible 60 years ago. And the cost of information connectivity is less than 1% of the cost incurred in building a road. Particularly compared to textile or other manufacturing, the investment required in ICT is a lot less, whereas the turnaround time in bringing the benefits to the masses for creating jobs is much faster, thus, ICT could be the panacea to help us bail out of the current recession a lot quicker.

This paper highlights some new economic opportunities generated by the emerging technologies in ICT, which could result in job-creation and contributing to the economic growth.

## 2. INITIATIVES OF TECH ACCESS, PAKISTAN

Tech Access, Pakistan, was founded almost a decade ago, with the vision to "bring latest technology to the region, create hi-tech jobs for our youth". At present Tech

Access has over two hundred capable I.T. professionals, representing the company in two continents, Asia and Africa; four countries and six cities. Tech Access represents world-renowned brands in hardware and software, and provides employment opportunities to work and excel in ICT. Some of the ex-employees of Tech Access are now serving in multinational companies around the globe, earning good name for themselves and for the country.

One of the small contributions of Tech Access to the ICT Sector of Pakistan was to assist in the formation of Corporate Advisory Council (CAC) with School of Electrical, Electronics and Computer Sciences, which operates under National University of Science & Technology (NUST). This initiative was to boost ties between academia and industry.

The credit goes to Dr. Arshad Ali of SEECS-NUST, whose untiring efforts made this forum a reality. This forum is for the university-industry partnership to promote economic activities at the grass-root level. As providers of trained and skilled human resource to industry, the universities need to play an active role in building associations with mercantile entrepreneurs, so as to ensure optimal utilization of the best available human capital. From a mere concept in 2006, CAC became a vibrant reality. Thanks to the cooperation and support of industrial entrepreneurs, SEECS Corporate Advisory Council is increasingly engaged in building sound academia-industry linkages and fueling much- needed interaction.

Another initiative of Tech Access is to launch a research and development centre at SEECS campus located in Islamabad, to further engage the university-faculty and students on high-tech projects of ICT industry. This, in turn, would help students prepare for industrial challenges, and build required skill-sets in the passing-out graduates, who could get readily absorbed in industry and provide constant feedback to academia as to where industry is leading, thereby bridging the gap between the two.

It can be confidently stated that the pattern of economic growth should be favourable to employment-generation. It is important, therefore, that employment and manpower-related concerns be linked with national economic policies, particularly relating to the development related and utilization of human resources.

ICT play a major role in all aspects of national life: the economy, as well as in social and cultural development. It is rapidly transforming our lives, the way we do business, access information and services, communicate with each other and entertain ourselves. It boosts the global economy. It also relates to human rights, helping to support freedom of expression and right to information.

It is argued that ICT, if supported with the right policies and with cross-cutting and holistic approaches, will complement and strengthen other multi-sectoral efforts that are required for creating jobs, resulting in economic growth.

## 3. POTENTIAL OF ICT

Today, ICT and wireless technologies make it possible to provide instantaneous access to knowledge and information that was not possible 60 years ago. The cost of information connectivity is less than 1% of the cost incurred in building a road. The investment required in ICT, particularly compared to textile or other manufacturing concerns, is a lot less, whereas the turnaround time in bringing the benefits to the masses for creating jobs is much faster, and ICT could be the panacea to help us out of the current recession a lot quicker.

### 3.1 Examples from the Developing Countries

It is a fact that new economies are being created by exploiting the potential of emerging technologies. India, in particular Bangalore, is often cited as an example of how the potential of ICT can be harnessed as a catalyst of economic growth. With its software exports of over six billion dollars, a rapidly expanding outsourcing sector and a large call-centre industry, it is difficult to overlook.

Some general facts and figures paint a clearer picture of the tremendous growth in the software industry in India:

- Two hundred-fortune 500 companies outsource to India;
- Over 400,000 skilled workers are employed in the software industry;
- Thirty per cent of Silicon Valley start-ups are started /headed by people of Indian origin, who often return to India with capital and expertise;
- Venture capital infusion has rapidly grown from 15 million dollars in 1996, to 450 million dollars in 2000, with a projected total of 10 billion dollars by 2009.

The strategy pursued by India and those who would follow in its wake is the establishment of ICT clusters. These ICT clusters fall under various categories, but are often called software/hardware parks or incubators. While the names vary, their objectives are common, namely:

- Fostering synergies and the collective effort for the production, and ultimately the export of ICTs (software and/or hardware);
- Establishing centralized, state-of-the-art physical and virtual facilities, to attract direct foreign investments from transnational corporations; and
- Establishing centralized, state-of-the-art physical and virtual facilities, to encourage, promote and nurture or 'incubate' domestic enterprises and entrepreneurial efforts.

Another remarkable example is of Malaysia, where the Multimedia Super-Corridor (MSC) was conceived and launched in 1996, as an initiative to encourage national and international investment in ICT. With the MSC and complementary initiatives, the government saw an opportunity for positioning Malaysia as a competitive economy,

with the hope that growth in the ICT sector would generate a spill-over effect to the rest of the economy. The Malaysian government offers MSC-status, which provides incentives for national and foreign investment in Malaysia. This measure positioned Malaysia on the ICT map in the world, and it is now considered to be an advanced country from ICT perspective and thus making major contributions to the economic developments for the country.

In Bangladesh, the Grameen Bank is best known as a micro-credit institution and an NGO, but less for its pioneering ICT-work among the poor. It started with the mobile telephone programme, called the Grameen Phone, and has become the largest mobile operator in Bangladesh, having 70% of market share. It has lately expanded to other ICT sectors, becoming the largest Internet-Service Provider. Grameen Communications has set up Internet kiosks in villages, while Grameen Software and Grameen Star Education are franchising IT education all over Bangladesh, to build human resource base for the growth of IT businesses.

## 4. CONCLUSION

A Chinese philosopher once said "Give a man a fish, and you feed him for a day. Teach a man to fish, and you feed him for a lifetime". Thus, it is suggested that one should make the policies favourable around ICT initiatives, in order to encourage the entrepreneurship, and create new services, which could help create a job-market and in result help our economy to grow.

# VIRTUAL EMPLOYMENT: HARNESSING THE POTENTIAL

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**ABSTRACT ONLY**

**ABSTRACT**

*The Global Virtual Assistance Network (GVAN), is an idea for a global business to facilitate the economic advancement of women in the developing world, through virtual entrepreneurship. A key objective is to connect women (currently constrained by physical or cultural barriers) to the market for their skills, no matter where that market is located.*

*This idea of generating employment through a global network is relatively new, but is a potentially rapidly growing service-sector. This is a service sector that has the potential of generating hundreds of thousands of employment opportunities, substantially increasing incomes, as well as resulting is an increased gender mainstreaming.*

**Keywords:** Women, Developing world, Employment, Global Cooperative, Computer networking, Virtual assistance.

# ICTs AND EMPLOYMENT OPPORTUNITIES FOR YOUTH AND FEMALE POPULATION

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**ABSTRACT ONLY**

**ABSTRACT**

*There has been rapid progress in the development of ICTs by the Government. The enhanced communication infrastructure, low-cost communication services and its accessibility to rural localities are among the few visible developments. This has opened many futuristic business-growth activities in Pakistan.*

*There is need to introduce the public and private-organizations collaborative models, in which new economic development and employment opportunities are visualized and the developments in ICTs are utilized for the benefit of public on the whole. This can help in sustainable growth of ICTs in Pakistan as well.*

# Environment

# CAPACITY-BUILDING AND EMPLOYMENT-GENERATION IN THE FIELD OF SATELLITE REMOTE-SENSING

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**ABSTRACT**

*The need for monitoring terrestrial systems that observe, quantify and map changing land-use; search for and protect natural resources and track interactions within the biosphere, atmosphere, hydrosphere, and geosphere, has become a paramount concern to managers, politicians, and the general citizenry in developed and developing nations. This need has led to extensive international programmes, for example, International Geosphere Biosphere Programme (IGBP) and the International Global Change Programme (IGCP), in order to use a variety of technologies, centered on observation-systems from space, to improve our ability to oversee and regulate the systems that govern Earth's effective operations. Remote sensing is the practical, orderly, and cost-effective way of maintaining and updating information about the world. Satellites are being used for weather forecasting, land-use/land-cover studies, snow estimation, flood monitoring, environmental monitoring, hydrological studies, forest changes and soil studies, thus making the subject one of the prime focuses on S&T during the last few decades.*

*Mostly, the remote sensing is carried out by receiving and measuring reflected and/or emitted radiation from different parts of the electromagnetic spectrum (ultraviolet, visible, reflected infrared, thermal infrared, and microwave). The data is utilized by computer-based programmes to produce images of scenes or to serve as digital inputs to analytical programmes. The remote sensing related computer programmes store, integrate, and analyze information that has a practical value in many fields concerned with decision-making for resource-management, environmental control, as well as site-development. Remote sensing has become a major technological and scientific tool for monitoring planetary surfaces and atmospheres. There is tremendous scope of satellite-based remote-sensing in Pakistan, in the areas/fields such as climate-change, hydrology, snow, agriculture, forest, oceanography, land-use/land-cover and geology for the impact-assessment, assessment of mitigation options and adaptation of a host of relevant mitigation technologies. Thus, the database, provided by the remote-sensing applications, supply very useful and real-time information for decision-makers and planners and can play a significant role in the development and planning, and subsequently for improving the economy of Pakistan.*

## 1. INTRODUCTION

From the surface of Earth, mankind normally experiences our world from a more or less horizontal viewpoint and, hence, its scale of observation is restricted to a few square miles at the most, owing to limitation put by natural as well as man-made structures, but gets more extensive while we are on a vertical or high oblique perspective, say tall building or a mountain-top or an airliner cruising above 30,000 feet. Such a position/location empowers us with a myriad of surface-features, as they would appear on a thematic map in their appropriate spatial and contextual relationships. This is why remote sensing is carried out from airborne platforms, such as airplanes and spacecraft, with on-board sensors that survey, record and analyze surface-features over extended areas from above, independent of the immediate proximity of the neighborhood.

Use of remote-sensing is not a very new idea. Its use began on the ground, then went aerial in the second half of the 19$^{th}$ century, next onto airplanes in the first part of the 20$^{th}$ century, and by the 1960s entered space, as cameras and electronic sensors and were flown on spacecraft to commencement of the era of 'Satellite Remote Sensing' (Figure-1). Not only can a range of sensors analyze radiation in the visible but also in

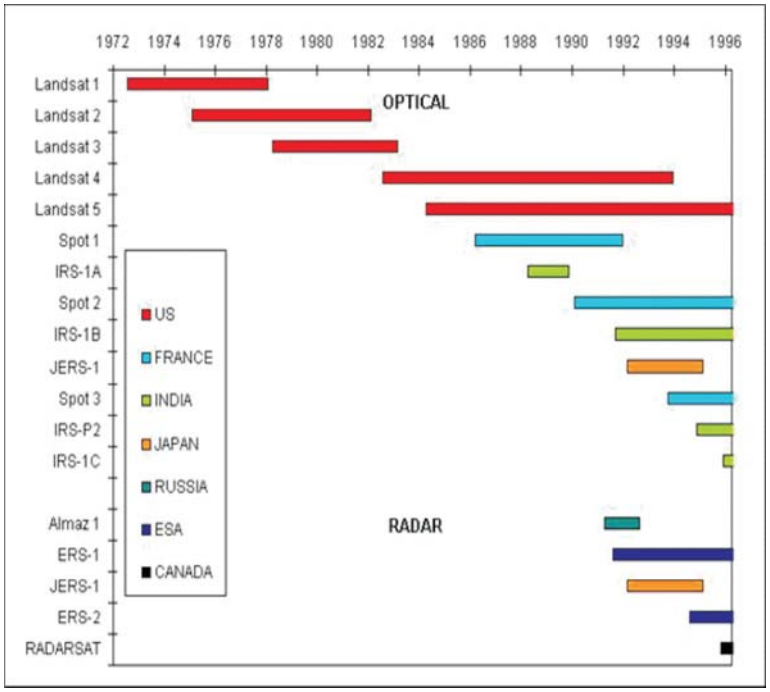


**Figure - 1: Various Satellite Systems Administered by Different Countries from 1972 to 1996**

the shorter or longer wavelengths within the electromagnetic spectrum. Remote sensing uses instruments that possess sensors to view the spectral and spatial relations of observable objects and materials at a distance, typically from above them by looking out. It is the practical, orderly, and cost-effective way of maintaining and updating information about the world.

Remote-sensing and Geographical Information Systems (GIS) are cutting-edge technologies of present day in observing the issues at macro scale. Most remote-sensing data consists of receiving and measuring reflected and/or emitted radiation from different parts of the electromagnetic spectrum. Those parts of the spectrum most commonly sampled are the ultraviolet, visible, reflected infrared, thermal infrared, and microwave segments. Multispectral data is the closely related multiband-data consisting of radiations collected over sets of electromagnetic radiation that are individually extended over, usually narrow intervals of continuous wavelengths within some parts of the spectrum. Each interval makes up a band or channel. The data are utilized by computer-based processing, to produce images of scenes or to serve as digital inputs to analytical programmes. Multiband images collected by one sensor usually exhibit considerable differences from one band to the next. This is because the radiation from point to point in an array of sampling areas, making up a scene, will vary depending on the reflectance or emittance response of various features/materials that are different within an interval and different again when other bands are examined. The band-to-band response, in terms of magnitude or intensity of radiation of any such point can be interrelated to become the spectral signature for a given feature or class of materials. Different features/classes have differing and normally distinctive signatures. Table-1 convinces us that remote sensing has become a major technological and scientific tool for monitoring planetary surfaces and atmospheres. In fact, the budgetary expenditures on observing Earth and other planets, since the space-programme began, now exceed $150 billion. Much of this money has been directed towards practical applications, largely focused on environmental and natural-resource management.

## 2. APPLICATIONS OF RS-GIS

Remote sensing has a range of applications that have been briefly summarized in Table-1. All of these applications are applicable in our daily life and many others have been developed and experimented. GIS integrate remotely sensed data with other spatial data types, as shown in Figure-2, and help us in decision-making, resource management, environmental monitoring, and site-development. Monitoring of terrestrial phenomena, environmental and climate changes, urban planning and development, and all important aspects in hydrology, geology, oceanography, etc., require global cooperation. Presently, this cooperation is being done through two programmes, IGBP (International Geosphere and Biosphere Programme) and IGCP (International Global Change Programme).

**Table - 1: Applications of Remote-Sensing Data**

| Agriculture, Forestry and Range Resources | Land Use and Mapping | Geology |
|---|---|---|
| Discrimination of vegetative types:<br>- Crop types<br>- Timber types<br>- Range vegetation<br>Measurement of crops acreage by species<br>Measurement of timber acreage and volume by species<br>Determination of range readiness and biomass<br>Determination of vegetation vigor<br>Determination of vegetation stress<br>Determination of soil conditions<br>Determination of soil associations<br>Assessment of grass and forest fire damage | Classification land uses<br>Cartographic mapping and map updating<br>Categorization of land capability<br>Separation of urban and rural categories<br>Regional planning<br>Mapping of transportation networks<br>Mapping of land-water boundaries<br>Mapping of fractures | Recognition of rock types<br>Mapping of major geologic units<br>Revising geologic maps<br>Delineation of unconsolidated rock and soils<br>Mapping igneous intrusions<br>Mapping recent volcanic surface deposits<br>Mapping landforms<br>Search for surface guides to mineralization<br>Determination of regional structures<br>Mapping linears |
| **Water Resources** | **Oceanography and Marine Resources** | **Environment** |
| Determination of water boundaries and surface water area and volume<br>Mapping of floods and flood plains<br>Determination of areal extent of snow and snow boundaries<br>Measurement of glacial features<br>Measurement of sediment and turbidity patterns<br>Determination of water depth<br>Delineation of irrigated fields<br>Inventory of lakes | Detection of living marine organisms<br>Determination of turbidity patterns and circulation<br>Mapping shoreline changes<br>Mapping of shoals and shallow areas<br>Mapping of ice for shipping<br>Study of eddies and waves | Monitoring surface mining and reclamation<br>Mapping and monitoring of water pollution<br>Detection of air pollution and its effects<br>Determination of effects of natural disasters<br>Monitoring environmental effects of man's activities (lake eutrophication, defoliation, etc.) |

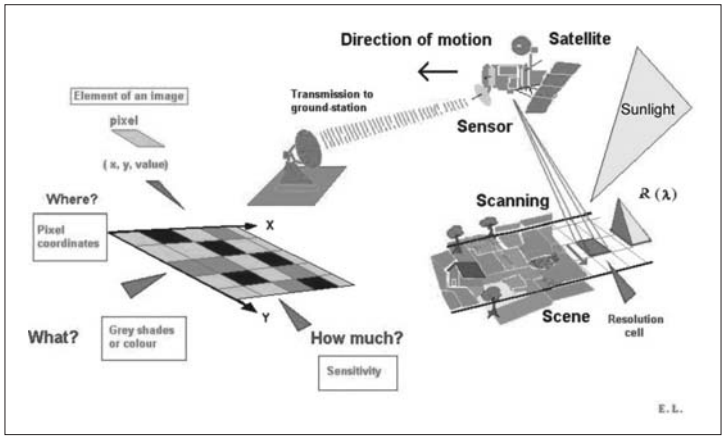


**Figure - 2: Integration of Remotely Sensed Data with Other Spatial Information for Decision-Makers**

## 2.1 Monitoring of Climate-Change

One of the most important applications of remote-sensing is to monitor global changes occurring in Earth's natural systems. Remote-sensing can play a vital role is monitoring atmospheric temperature changes, air and water pollutants, global climate-change and its impact on living organisms. Monitoring climate-change and its effects, requires continuous observation ranging from years to decades, and remotely sensed data provides efficient means to analyze it. RS-GIS together can help us to better understand climate change and to project the natural hazards well before they cause damage. One of the very important application of remote-sensing in the field of climate-change monitoring is shown in Figure-3. The ozone-hole over the Antarctic region from the year 1979 to 1999, as analyzed with the help of remote-sensing data.

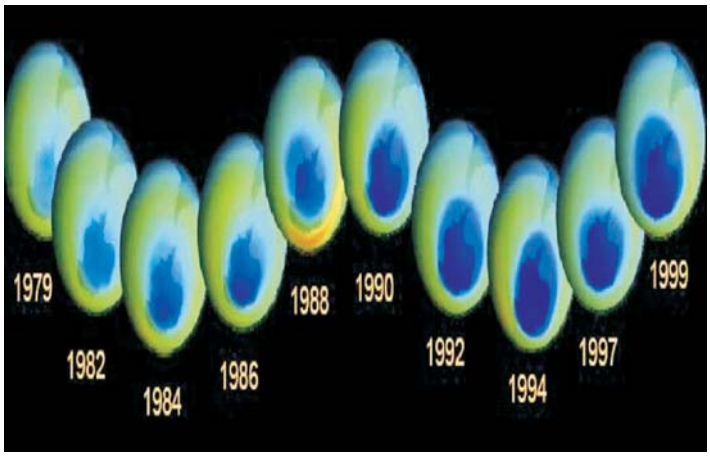


**Figure - 3: Darkest Blue Areas Represent Regions of Maximum Ozone Depletion**

## 2.2 Applications in Hydrology

RS-GIS has immense significance in hydrology, as it helps to map and monitor the distribution of water on the Earth's surface. Hydrological phenomena are continuously changing on Earth, so these should be observed regularly for better planning in forestry, agriculture, land cover, and flood-affected areas. Remote sensing provides efficient and immediate solutions to problems caused by hydrological processes and thus has tremendous importance for flood-forecast agencies, hydropower companies, conservation authorities, city planning, and emergency-response departments. Figure-4 shows Mangla watershed classification, based on satellite data of 15$^{th}$ September 2005.

## 2.3 Applications in the Field of Snow

A large area in the north of Pakistan receives precipitation in the form of snow.

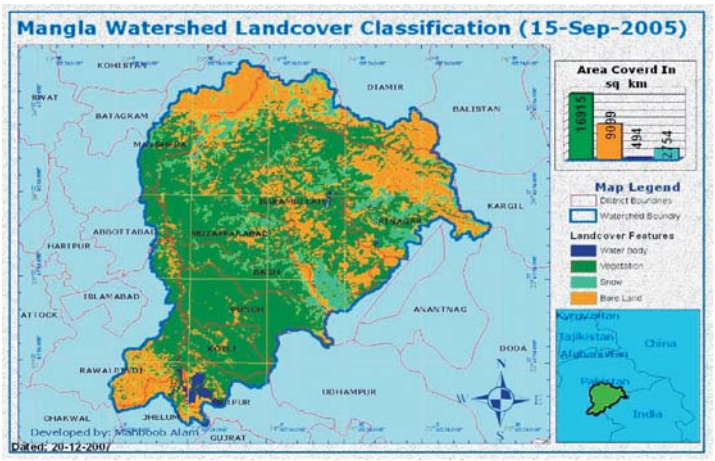


**Figure - 4: Mangla Watershed Classification (15 September 2005)**

Remote- sensing techniques can be employed to map these snow-covered areas. These techniques can be used to classify snow and ice types and to quantify ice-thickness in these areas. Remote sensing can also play a vital role in monitoring the melting-process of glaciers. A cautious monitoring of melting glaciers can help prevent devastation in human settlement areas, due to flooding.

### 2.4 Oceans and Coastal Monitoring

Oceans are very important for human and marine lives and for developing open-ocean and off-shore weather systems. Ocean dynamics can be monitored by remote-sensing to assess fish stock, better ship-routing, predicting global circulation, forecast and monitor storms. By using remote sensing, coastal settlements can be mapped and monitored. Analysis of ocean colour, which indicates the health of the ocean, and monitoring of oil- spills that effect marine life and human habitat, can be done by using remote-sensing techniques.

### 2.5 Applications in the Field of Agriculture

Remote sensing can greatly help to map various crops and soil-productivity, and to timely predict crop-yield. Remote-sensing techniques can facilitate analysis of the factors that may cause low crop-yield and crop-damage, due natural hazards. Satellite and airborne remote-sensing provide reliable methods for crop-area estimation and to keep an eye on health of vegetation.

### 2.6 Forestry Monitoring

Forests are of vital importance to mankind and other plant and animal species, as they provide them oxygen and create a $CO_2$ balance in the biosphere. Deforestation and

depletion of forests by human activities or natural hazards is one of the major concerns of the present age. Reduction in forest-areas can create imbalance in nature and, thus, can alter Earth's climate. Remote sensing can help us monitor deforestation and replanting, facilitate prompt-control of forest fires, and recognition of forest types.

### 2.7 Geology

Geology is the study of exploration of minerals, hydrocarbons, earth-related potential hazards, such as volcanoes, landslides, and earthquakes. Geological studies are critical for urban planning and constructions. Remote sensing can be used to study the land-surface structures, location of fault lines, and recognition of potentially dangerous zones of seismic activity. Knowing about geological activities, using remote sensing techniques can help us to choose seismic-free and geologically inactive sites for putting up edifice. Oil and mineral explorations can also be done efficiently by employing remote sensing techniques.

### 2.8 Land-Cover and Land-Use

Land-cover refers to the surface-cover on the ground by various features of Earth, such as vegetation, soil, forests, crops, etc., while land-use refers to the purpose the land serves, for instance, wildlife habitat, or agriculture. Recognizing, defining and mapping land-cover is significant for global monitoring studies, resource-management and planning activities. Remote sensing provides efficient ways to see what quantity of land is in what type of use. It can also help us classify the types of land in use. Land-cover mapping provide a basic inventory of land-resources for government, environment agencies, and private industry throughout the world. Figure-5 shows land-use and land-cover of Islamabad for the year 2002.

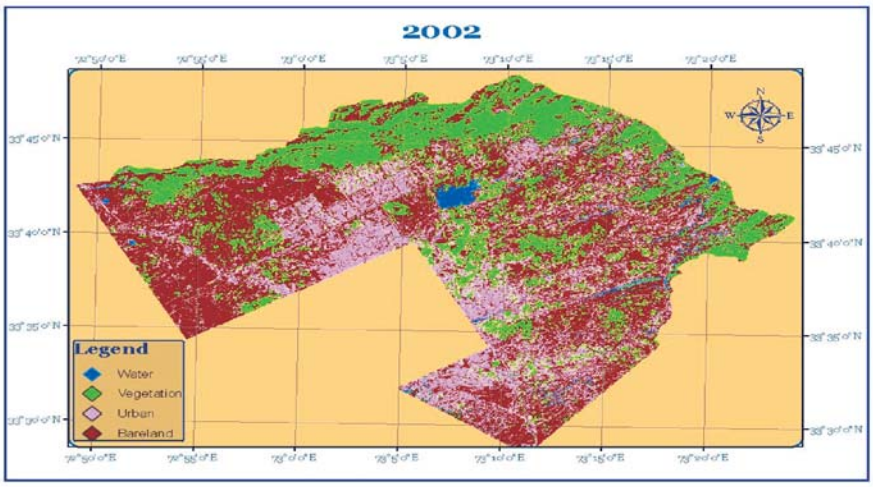


**Figure - 5: Land-use and Land-cover of Islamabad for the Year 2002**

## 3. CONCLUSION

Timely and up-to-date availability of information to the policy-makers is the first key to quick decision-making for measures relating to sudden weather changes and thus sustainable development of a society. Mankind is beset with many towering challenges, as the social and scientific scenarios are continuously changing. In order to keep pace with the modern-world, cutting-edge technologies have proven to be useful. This is why satellite remote-sensing can provide consultancy, solutions, and future trends in the areas of climate-change, hydrology, snow, agriculture and forest, oceanography, land-use, land-cover and geology, for the impact-assessment, selection of mitigation options and adaptation of a host of relevant mitigation technologies.

Economy and social factors go hand in hand, with respect to quality of life. The better the indices of socio-economic factors, the better the society will progress. In Pakistan, there is tremendous scope and need for the transfer of information to suitable technology and expertise in the areas of climate change, hydrology, snow and ice, agriculture and forest, oceanography, land-use and land-cover and geology for the assessment of impact and assessment of mitigation options. These expertise are sporadic and limited to very few institutions as well as are short-term in utility.

# EMPLOYMENT GENERATION AND NATIONAL ENVIRONMENT POLICY OF PAKISTAN

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**ABSTRACT**

*Pakistan is facing multiple problems, poverty, unemployment and unsustainable economic growth. The current global recession has further aggravated the problems of economic development and employment generation. In the past, job-creation strategies in Pakistan have laid emphasis on producing employment in the public sector, with increasing inflation and huge economic losses to national exchequer. In addition to the introduction of new technologies in the industry and service sectors, the demand of human labour is decreasing.*

*The adoption of strategies for sustainable-growth offers great opportunities of employment- generation, along with natural resource conservation. There is an urgent need to shift Pakistan's present economy to one that is environmentally sustainable, with a potential of providing socially beneficial employment to its workforce. Agriculture, forestry, energy, manufacturing and services are the main sectors that, if managed on sustainable basis, can achieve the dual targets of sustainable development and employment generation.*

## 1. INTRODUCTION

It is generally considered that any developmental policy aimed at protection of environment will have adverse consequences for the economy, making local industries and businesses uncompetitive, forcing them to close or delay the new projects and, consequently, lead to further unemployment. However, recent studies have shown that the projection of environmental policies as "job killers" has lost its argument (ETUC, 2007), because:

- The actual costs of compliance with environmental regulations have been far below the estimates;
- Smart innovations and better management-practices give a positive competitive edge to the companies observing environmental regulations, rather than putting them at disadvantage;
- Many studies from US and Europe have shown that there have been few job-losses

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after the implementation of environmental regulations and these are insignificant, as compared to job losses from other economic and management factors; and

- Adoption of environmental policies has resulted in the creation of a new category of "Green Jobs", whose demand is growing continuously worldwide. At present, these jobs are mainly in the fields of pollution-control and waste-management, but these jobs are being shifted to renewable energies, pollution prevention and green productivity, etc.

From existing jobs in pollution-control to the growing employment in recycling and remanufacturing, to emerging jobs in connection with stepped-up energy and materials- efficiency projects and the development of renewable energy sources, like wind and solar power, to future occupations in providing goods and services that are more durable, repairable, and reusable; there are many opportunities for sustainable employment (UNEP, 2008).

## 2. PAKISTAN'S NATIONAL ENVIRONMENT-POLICY

Pakistan's National Environmental Policy was prepared to provide "an overarching framework for achieving the goals of sustainable development, through protection, conservation and restoration of Pakistan's environment" (GOP, 2005). Its main objectives are to:

- Secure a clean and healthy environment for the people of Pakistan;
- Attain sustainable economic and social development, with due regard to protecting the resource-base and the environment of the country;
- Ensure effective management of the country's environment, through active participation of all stake-holders.

### 2.1 Environment Policy and Employment

By looking at various conceptual and practical aspects of this policy, it can be seen that it supports the following actions:

- The transition of Pakistan's economy on an ecologically sustainable basis, where long- term stable employment opportunities exist;
- Strategies to provide safe, meaningful, environmentally and socially beneficial employment for all who wish to work; and
- A commitment by the Government for fulfillment of full employment objective, in a changing economy, by providing vocational and training facilities, incentives for private enterprises to create more job openings, and support to weaker and unprivileged sectors of the population.

### 2.2 Some Key Sectors for Employment-Generation

Though our national environment-policy provides guidelines for intervention in a number of key sectors, such as water, energy, agriculture, forestry, biodiversity, air-

quality, pollution and waste control, to achieve its objectives, its implementation in the following particular sectors will provide immediate and large-scale improvement in generation of employment- opportunities.

### *2.2.1 Sustainable Agriculture*

Agriculture is the backbone of Pakistan's economy and it is necessary to shift to sustainable agricultural and livestock development. Some main activities in this regard are to:

- Promote organic farming;
- Encourage ecologically compatible cropping systems;
- Enhance existing livestock-production, through development of new technologies, scientific methods of farming and improved management interventions;
- Payment for environmental services, improved natural resource management.

### *2.2.2 Forestry and Plantations*

Forests and tree plantations are a great asset for any country and their conservation and expansion is helpful in safeguarding economic growth and food security in the country. There is need for:

- Support of projects for growth of plantations on cleared, marginal lands for wood production, by banning harvesting of local forests;
- Introduction of a large-scale training programme in the wide range of activities necessary for successful revegetation programmes;
- Promoting agro-forestry.

### *2.2.3 Energy*

Pakistan's environment policy supports the redirection of current energy-policy, with the aim of reducing pollution and greenhouse gas emissions, through energy-efficiency and renewable energy measures. This shift will provide a major boost to our efforts to provide green jobs to our people.

### *2.2.4 Green Manufacturing*

The market of the world for environmental products and services is expected to grow into billions of dollars industry and, if Pakistan is able to capture just 1 to 2% of this market, it would be worth $0.5 to 1.0 billion to Pakistan's economy. Our environmental policy suggests the following recommendations, which will have positive effects on our job-market also.

- Incentives for the establishment of a manufacturing base for environmentally beneficial goods and services;
- Introduction of innovative concepts, such as dematerialization, remanufacturing, "zero-waste," closed-loop systems, making products more durable and repairable, and replacing products with efficient services, have great potential for opening new avenues of large-scale employment.

### *2.2.5 Ecotourism*

Pakistan is blessed with the highest of mountain peaks, mighty glaciers, great deserts, beautiful valleys and archeological sites, which have a great attraction for tourists. Attracting tourists to visit natural areas and historical monuments of Pakistan must be managed adequately, to sustain our tourism sector and to conserve natural and historical capital. The following suggestions may be of help:

- Greater allocation of funds and other resources for the protection and development of protected areas. This management should be made labour-intensive to provide job-opportunities, particularly to the local inhabitants;
- Enhancement of employment-opportunities in tourism sector, to improve management of natural and cultural values of an area; and
- Expansion of cultural tourism in specific areas, resulting in greater employment- opportunities for local people.

## 3. SOME CONCERNS ABOUT TRANSITION TO A SUSTAINABLE SOCIETY

The shift from a resource-depleting, energy-inefficient and waste-generating economy to a sustainable and low-carbon economy will involve technological innovations, changes in business and investment strategies and a new set of social and political paradigms. The environmental policy is expected to produce large-scale, new job opportunities but it will also lead to job losses and have negative impacts on livelihoods in certain regions, communities, industries and sectors. This loss will be more prominent in fossil-energy intensive industries, extractive industries and old transport and communication sectors. To avoid this problem, it is necessary to plan for "just and fair transition", whereby those affected by the changes are adequately assisted, and the new opportunities created are shared by specific groups of workers, social groups, and communities.

The journey towards sustainable economy will require the removal of disparities between "haves" and "have nots" at local and international levels. It will ensure to farmers the payment of a fair price for their produce, and workers being treated equitably in terms of their pay, working conditions, and basic rights. It will also require governments to be proactive in their efforts to ensure that all citizens have access to a decent standard of healthcare, education, and habitation.

A sustainable economy cannot be built on "green for a few, a relatively limited number of workers, and with regrettably few positive outcomes overall. It must mean "green for all" — creating decent work and stable communities and allowing for a fairer distribution of wealth (Canadian Labour Congress, 2000). Pakistan's Environment Policy includes recommendations and pathways to make this journey a success. In this regard, the key challenge for government, companies, labour unions, and environmentalists is to undertake measures to de-link employment from a high volume of material-inputs and make efforts to implement environment-policy with full dedication.

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# ROLE OF COMMUNITY-BASED SUSTAINABLE PROJECTS IN CREATING GREEN JOBS AND ENVIRONMENTAL PROTECTION

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**ABSTRACT**

*The employment situation in Pakistan is very unsatisfactory and there is a challenge or an opportunity to start a shift from a "trade off" between jobs and environmental protection, to a new level of integrated and environmentally sound development policies. This paper discusses the economic and environmental benefits of developmental projects and suggests measures to increase the role of Community-based Organizations (CBOs) in creating jobs and contributing to the socio-economic well-being of the country.*

## 1. INTRODUCTION

The employment situation in Pakistan is very unsatisfactory and this problem is growing day by day due to population growth, unjust economic policies and constraints related to natural resources. The nexus between job-creation and environmental protection is gaining importance because each country, while increasing income-generation and job-creation, is faced with the challenges of pollution, climate-change, resource-depletion and traffic congestion, etc. There is a challenge or an opportunity to start a shift from a "trade off" between jobs and environmental protection to a new level of cooperative and integrated, environmentally sound development policies.

Now, local governments and community-based organizations have a greater share in planning and implementation of development-projects related to housing, transport, sanitation, water supply and education. If these projects are planned and executed according to the principles of sustainable development, they will not only help improve the environment but will also create jobs and wealth. Such initiatives can help in achieving sustainable development through creating linkages between community development, social justice, public health and creation of green jobs.

## 2. INNOVATIVE GREEN INFRASTRUCTURE PROJECTS

There is a great potential for generating employment and creating wealth through the projects aimed at making our human settlements (rural and urban) more sustainable,

efficient and livable. Previously, there has been little comprehensive work on potential environmental and employment effects of community-based sustainable development projects, the following areas are suggested for priority action:

### 2.1 Green Construction

The buildings designed and built by the construction-sector in Pakistan use and waste resources during the construction and need large supplies of materials and energy for their maintenance. Green construction aims at building healthier, resource-efficient structures by introducing improved ways of how buildings use energy, water and materials. A shift to "green construction" will create a demand for new generation of building-materials, industrial products and technologies, resulting in increase of job opportunities in: manufacturing, energy-efficient systems, low-waste methods, paints and ceramics, etc.

### 2.2 Public-Sector Transport, with Mass-Transit Systems

One of the major causes of environmental degradation in Pakistan is its old, inefficient and pollution-generating transport-system. There is a great potential for environmental and social improvement through the use of greener forms of transportation. It includes projects of mass-transit, light rail, efficient and regular bus services, discouragement of car-culture, popularization and facilitation of bike-use and increasing fuel-efficiency of existing modes of transport. These projects will provide better transport for a larger population, decrease pollution and improve quality of life. These projects have the potential to provide jobs in the areas of traffic-engineering, sustainable traffic-management, construction of roads and railway lines, vehicle repair and maintenance activities.

### 2.3 Improvement of Resource-Using Efficiency of Existing Buildings

Energy-efficiency projects are a huge win for local communities, from both the environmental and economic job perspectives. Incorporating concepts of energy-efficiency, into building design, construction, and retrofits, can reduce energy-use and energy-bills significantly. It can also create jobs in energy-efficient product manufacturing and installation, as well as general construction jobs.

## 3. SKILL-DEVELOPMENT PROGRAMMES

To provide a dedicated and adaptive workforce equipped to meet the growing demand of new kind of jobs and professions, large-scale vocational and skill-development programmes should be launched in our educational institutions. If needed, the local education-management authorities can set up new institutions, in accordance with the local conditions. These programmes could provide employment opportunities for experts and graduates in various disciplines. To achieve the economic, environmental and social- equity objectives of sustainable development, the community-based

organizations have to consider the following points as pre-requisites for the success of their projects:

### 3.1 Analysis of Economic Profile

These organizations should analyse objectively the economic situation of their respective areas, including the strength of the market, supply and demand scenarios, natural- resource potential and future demographic and socio-economic projections. They should aim at harnessing the local competitive advantages (abundance of a natural resource, provision of skilled labour, etc) before launching any project. In addition, since achievement of sustainable economic development is a relatively new field, its projects are prone to failures. One challenge facing sustainable initiatives is the careful assessment of risks and problems.

### 3.2 Improvement in Organizational Structure

Along with economic knowledge, these organizations should improve their organizational structure, with strong management and leadership and workforce that is skilled, entrepreneurial, flexible, and politically motivated. In addition, their leadership should be able to incorporate initiatives to link national and global codes of sustainable development with a broader vision.

### 3.3 Inter-Organization Cooperation

For such comprehensiveness to work successfully, environmental community-development organizations must increase their linkages with one another. They should share their knowledge and experiences to guide emerging organizations. In addition, a comprehensive network must be established between financial institutions, government departments, experts, local businesses, and local leaders.

### 3.4 Establishment of New Infrastructure

In the recent past, there has been a rapid expansion in the fields of housing, multi-purpose buildings, roads and private educational institutions. To manage these developmental activities on sustainable basis, a new infrastructure should be created to meet all the needs of sustainable initiatives, especially technical assistance, community-mobilization, monetary provision and quality-control.

## 4. COMMUNITY-BASED SUSTAINABLE DEVELOPMENT

Community-based Organizations (CBOs) are now entering into a new era of planning and implementing developmental activities in accordance with the principles of sustainable development. To achieve this target, CBOs have to adopt multi-disciplinary and inter-sectoral community-development policies. In a developing country like Pakistan, this connection would especially be beneficial for low-income,

poor communities that are generally deprived of the benefits of developmental projects and are more exposed to environmental degradation.

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# Miscellaneous

# THE ROLE OF D.o.S.T IN PROMOTION AND CREATION OF JOB OPPORTUNITIES: THROUGH VARIOUS DEVELOPMENT PROGRAMMES OF SCIENCE AND TECHNOLOGY IN N.W.F.P.

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**ABSTRACT**

*What separates success from failure in this new environment is the ability of a nation to develop innovative products, processes and services, and underpin their economic progress by improving their quality of life. Every individual must therefore develop skills and knowledge required to see the country (Pakistan) through this economic transformation. The ability of Pakistanis, especially the youth, to acquire the skills necessary to understand science and technology, contribute to their future development, and make best use of them to meet economic and social goals, will be instrumental in transforming this country as the best place to live.*

*It is the societies investing in the skill of their people that today are global economic leaders. In the decades to come, as industry becomes more knowledge-intensive, the return on investment in development of technical manpower will increase. In Pakistan, human capital must be developed through proper education and formal and informal training. Underdevelopment of Pakistan is not so much due to poor resource-endowment as to the inability to exploit the available resources, because of inadequate S&T capacity.*

*Realizing the importance of S&T for employment generation, the Directorate of Science and Technology (D.o.S.T), Govt. of North West Frontier Post (NWFP) of Pakistan, has launched programmatic initiatives to contribute to job-creation. These initiatives create direct as well as indirect job-opportunities. The initiatives are: promotion and support of R&D efforts in public and private sectors; pilot research studies; promotion and development of renewable and alternate energy resources, strengthening of academia-industry-government linkage for commercialization of R&D efforts; establishment of S&T park and Technology business incubator, R&D for industries through universities and support-initiative for industrial innovation, to name a few. These initiatives potentially have a catalytic and multiplier effect on the job-market and, thus, contribute to poverty-reduction.*

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## 1. THE SHIFT TO KNOWLEDGE-ECONOMY

The economic order in developing countries, like Pakistan, is changing in the wake of two unprecedented challenges – globalization and emergence of knowledge-based economies. Instead of relying on financial resources, the knowledge-based economies rely on intellectual capital. Investment in increasing the quality and quantity of knowledge, in turn, enable indigenous development of information and communication technologies, while offering quality services at lower cost. Pakistan, like many other developing Muslim countries, faces three major developmental challenges: i. the increase of macro-productivity of the economy; ii. liberalizing trade and encouraging foreign investments; iii. government policies must support the shift towards knowledge-based economy. The primary challenge is to link the economy with knowledge, and to set guidelines for this linkage. The government must respond to the issues faced in shifting towards a knowledge-based economy, by setting well-defined goals, directions and initiatives. This requires building of institutions, partnerships and networks needed to link individual skills and talents. The government's response must be initiated in 2011 if it is to somehow catch up with the world at large. According to one of the studies, countries that don't respond to the global challenges now will face very tough challenges to its existence by 2020.

The Government of North West Frontier Province (NWFP) of Pakistan created the Directorate of Science and Technology (DoST) as an institution to pave the way for developing a knowledge-based economy. DoST has initiated to achieve the goal by promoting research human-resource development and facilitating promotion of S&T. Every move and intervention that DoST makes is a step towards the achievement of this goal. Tools used for achieving the goal are: innovation, R&D, human resource development, technological excellence, technology development, expansion of indigenous knowledge and technological base, as well as focusing on quality of education, alignment of education and research with market-demand, and promotion of S&T.

Every individual must, therefore, develop skills and knowledge required to see NWFP and Pakistan through this economic transformation. The ability of Pakistani youth to acquire the necessary skills will contribute to national and provincial economic development. Exchange of knowledge and information amongst government bodies, businesses and universities can help in easing the transformation of economic order.

## 2. PROGRAMMATIC INITIATIVES

All the programmes designed and implemented by DoST aim to improve the competitiveness of Pakistan at the global level. The following are some of the major programs launched so far:

## 2.1 Promotion and Support of R&D Efforts in Public and Private Sectors

It is a widely accepted fact that the capacity of many developing countries, including Pakistan, to carry out basic and applied research, is limited. Evidence shows that more work needs to be done to improve and strengthen synergies amongst industry, research and academic institutions. Since the final outcomes of any type of research extend over a long period of time, therefore industry and/ or private sector are least likely to invest in such long-term research activities. Therefore, governments, in most cases, become the sole bearers of the responsibility of funding and supporting basic and applied research.

Think Tanks are needed to create the required synergies between industry and the research institutions that are necessary for commercially driven work and its outputs. Academia can lend easy access to knowledge to the industry for conducting applied research. In turn, the technology produced by the industry can be used by the universities to carry out the basic research on a more detailed and extended level. Secondly, by enhancing close interaction with research centers, an added advantage can be achieved in the form of exploitation of their production and outcomes.

Accordingly, an Academia-Industry-Government Roundtable has been constituted (the first of its kind at the national level) in collaboration with Sarhad Chamber of Commerce and Industry, Peshawar. The usefulness and the uniqueness of the forum can be gauged from the fact that the Governor of NWFP and the Chancellors of the universities consented to become the Patron-in-Chief and an industrialist as the Chairman of the forum. The linkage of the triple helix is critical to socio-economic uplift and employment-generation. The forum has started functioning and the industry has responded positively. The strength of the forum is its ownership by the Sarhad Chamber of Commerce and Industry Peshawar. The forum met with tremendous amount of support from all the public and private sector universities throughout the province. Under the initiative an R&D fund had been established and Research promotion and support sub cell has been established in the University of Engineering and Technology with the aim to conduct real world and demand based research on the problems and issues identified by the industry. An award on 'Best research of Industrial importance' has been institutionalized to encourage researchers to focus their research efforts on industry. The basic aim of all these initiatives is to transform the industry to knowledge base and in the process generate employment. The recent decision taken to transform, develop and diversify Pharma industry (a rare success story of industrial development in Pakistan) through knowledge-input will turn it into a multi-billion industry and will certainly have a strong impact on the employment generation.

## 2.2 Establishment of Design Facilitation and Training Center (DF&TC)

The core objective of this initiative is: 'To nurture innovation through design facilitation for sustained economic development, growth and poverty reduction'. The

project is the first of its kind with a Technology Business Incubator (TBI) designed to cater to the designing, prototyping, reverse engineering and capacity-building needs of the small and medium sized enterprises (SMEs).

The promotion of entrepreneurship remains a critical task for the provincial government as it contributes to the large percentage of job-creation and economic growth, particularly because large corporations shed jobs and SMEs create jobs. The Directorate of Science and Technology, in conjunction with other government departments, semiautonomous and autonomous bodies, is providing access to a range of products and services, enabling the development and strengthening of SMEs. DoST will achieve the targets by forging alliances and partnerships with academia and other relevant institutions. In the pilot phase, the project would provide financial support to academia and/or relevant institutions, which, in turn, will offer technical support to the SME, in terms of technological solutions, services and training. To ensure cost-effectiveness, several similar or complementing ideas/ requests in the same sector would be grouped and provided the required support to save time and improve interpersonal and interfirms relationships. Support will also be provided in linking to the market, investor, business capital, etc. DF&TC will be a mother-center, which will in turn reproduce sector- and industry-specific centers catering to the needs of industry. The components of the first phase are:

## 3. COMPONENTS OF THE SUPPORT INITIATIVE

*'Support Initiative for Industrial Innovation (SIII)'* is providing technical and financial support/assistance to projects on request. SIII is focused specifically on the phase that begins at the conclusion of basic research (at the stage of proof of concept) and ends at the point where pre-production prototyping starts. The program is providing access to services and facilities available in the relevant institutions for this purpose. In exceptional cases, institutions where facilities and services are available will be strengthened in terms of equipment, machinery and training facilities. Financial support will also be provided to near-market and end-stage research that could result in new intellectual property, commercial enterprise and the expansion of the existing industrial sectors. In some special cases, as the situation demands support will be provided in procurement of consultancy-services for designing or improving a facility to undertake innovative activities, such as establishment of cluster-level multipurpose laboratories.

*'Initiative for Priority Skills Acquisition (IPSA)'* is a skill-empowerment organ of partner institutions, i.e. National Vocational & Technical Education Commission (NAVTEC), Technical Education Department, Skill Development Council, etc. The main objective is to speed up development of skills most needed to help the economy grow, focusing on areas that build and enhance innovation and reverse-engineering skills. IPSA aims to bring together relevant stakeholders in funding partnerships that enable participants to design tailor-made, training programs for technicians, para-technicians (misthrees, kharadis, machinists, etc.), which form the bulk of workforce

of the industry and desperately need capacity-building. It will be ensured that in every mini project undertaken, some capacity building of students takes place.

### 3.1 Studies

Capacity short-falls in the public sector demand pooling of intellectual resources for establishment of sector and industry-specific centers. So, in partnership with academia, industry and interested organizations, relevant studies will be carried out for the establishment of sector and industry-specific centers. The studies will also include development of mechanisms for technology-transfer and diffusion. The studies will end in formulation of bankable funding-proposals. The involvement of all the market-players would ensure ownership and, at the same time, reduce the communication deficit in the triple helix. Priority, though, would be given to the sectors that have the highest potential of innovation and that can readily transform to knowledge-base. Mapping of the services and facilities for innovation would also be carried out.

DF&TC will also design and run an awareness campaign, as very little is available in terms of knowledge of facilities, resources, services, appropriate technology, etc. This will enable linkage to the right institutions, needed facilities and resources. The targeted sectors as initially identified by Industry include: bricks, glass, marbles, automotive, agri-foods processing electronics, metal value-adding, chemicals, metal casting, composite and molded plastic, tool and die making, materials-based industry, creative industry, clothing and textile, wood, plastic industry, mines & minerals, automotive industry, pharmacy & medicines, food industry, software & hardware, pulp and paper. Provision will be kept for any outstanding effort in need of support, other than the above sectors. The interventions through the initiative in the above-mentioned sectors will definitely generate employment, particularly self-employment, hence alleviating poverty.

### 3.2 Award for 'Best Industrial Innovation'

In a bid to strengthen the national and provincial innovation systems and promote innovation in industry, the Directorate of Science and Technology has institutionalized an "Award for Best Industrial Innovation". For this award, following will be considered as an innovation:

- A new or significantly improved product or process;
- A new or significantly improved marketing strategy; and
- A new or significantly improved organizational structure or management practice.

The award will be given in the following Categories:

- Product Innovation

- Process Innovation
- Marketing Innovation
- Organizational / Management Innovation

### 3.3 Pilot Research Studies

Heavy dependence on the import of technologies, without building local technology infrastructure and capacity, has stifled the growth and creativity of the indigenous S&T sector. Science is increasingly becoming inter-and multi-disciplinary and calls for multi-institutional and, in several cases, multi-national participation, to encourage research and innovation in areas of relevance to the economy and society, particularly, by promoting close and productive interactions between private and public institutions in science and technology. This calls for a certain percentage of the overall allocation of each of the socioeconomic sectors to deploy for relevant programs and activities in science and technology development and in establishing linkages with national institutions. This arrangement can be worked towards creating synergies with relevant organizations, to carry out joint exercises in S&T.

S&T, because of its strong impact on the socio-economic conditions and livelihood, necessitates immediate attention, but the financial implications demand a cautious approach in order to avoid precious funds going waste. The most prudent approach would be to conduct studies on pilot basis (small-scale) so as to workout modalities for large scale investment.

The project has been designed to offer technology-based solutions to crises relating to energy, environment and food, focusing on promoting and boosting industrial activities and, in turn, generating employment and reducing poverty. The studies are being carried out in six sectors: energy, carbon finance, environment, agriculture, industry and education, to begin with, while additional sectors/areas for initiating pilot-projects are being identified. So far, three studies have been completed and 40 studies have been floated in the newspaper for selection of partners to carry out the studies, thus opening a number of new avenues of business and industrial development. Under the initiative Clean Development Mechanism facilitation cell and Renewable alternate energy precursor cell have been created to undertake studies and projects on carbon finance and energy. All the studies will basically open up ways for future large scale investments and thus result in poverty reduction.

### 3.4 Promotion of Science and Technology in NWFP

The foundation of sound education for creative scientific work has to be laid early. Most of the schools stress rote-learning for examinations. Little is done to cultivate a critical attitude and interest in the study of nature or experimental work. The number of schools that have adequately equipped science laboratories or libraries is small. Science teaching does not involve any 'doing' of science; it consists of giving information 'about' science. There is little understanding of the scientific method or of

creative scientific activity.

The best way to popularize and promote S&T is to target and sensitize young fertile brains of middle, secondary and higher secondary school students. Organizing a science model competition/exhibition could just do the trick and initiate a process towards a change in attitude. The healthy environment of competition would bring out of them a scientist in the making. The purpose of such an activity is to provide opportunity to children to test their creativity, knowledge and scientific genius and attempt to solve real-world problems in the process. Moreover, students thinking to change their disciplines and leave the study of science subjects would review their decisions. The underlying concept is to infuse a spirit of discovery in school/ college children and increase their interest in S&T.

A major portion of the populace, though illiterate/undereducated, has fertile brains and possesses capabilities to develop, modify and improve technologies. They only need some enabling environment to flourish and contribute to the cause of S&T. The current initiative will help to identify and encourage people with extraordinary capabilities in technology-development in the province.

Amazing benefits have been reaped so far, and a number of budding and extraordinary talented young scientists have been identified. Opportunities have been opened to people with virtually no education, but exceptional God-gifted capabilities. It is hoped that, by the end of the project, a crop of scientists and 10 best technologies identified for upscaling and having an obvious link to the market. The human resource thus promoted would go a long way in generation of employment and reducing poverty.

### 3.5 Establishment of Science and Technology Park

Science and Technology Parks are a means of supporting a knowledge-based economy and fostering market-oriented technological development. They typically accomplish this by bringing together academic, business and governmental organizations, into one physical location, and supporting inter-relationships between these groups through incentives offered by governmental policies. Since academic institutions tend to draw technically qualified personnel to a particular region, locations immediately near these institutions become prime candidates for such parks. The S&T Park, if realized, would be the first of its kind in Pakistan. The park is envisaged to create thousands of job opportunities and, thus, reducing poverty in a big way.

## 4. PROGRAMS IN THE PIPELINE

### 4.1 Creation and Institutionalization of 'Knowledge Management Unit'

The world today is witnessing a veritable knowledge revolution. Now, more than ever before, knowledge has become not only a key economic resource, but the key factor determining the competitive edge of corporate entities and countries alike. In a

**Box - 1: Aims and Objectives of an S&T Park**

**Objectives:**

An S&T park is an economic and technological development-complex, aimed at fostering knowledge-based economies by bringing together scientific research, business and governmental organizations in one physical location. The park complex also promotes technology innovation and incubation, training and facilities for exhibition and market-development.

- Promote and facilitate R&D by the university, in partnership with industry;
- Assist in the growth of new ventures;
- Promote economic development;
- Facilitate the creation and growth of innovation – based companies;
- Provide an environment where knowledge-based enterprises can develop close interactions with a center of knowledge for their mutual benefit;
- Promote the diffusion of results produced by university research and public research centers, and generate added value products;
- Promote, in collaboration with other agents, the creation of innovative technology-based companies and to facilitate sustainability and competitiveness, through their incubation in the Park;
- Stimulate quality in all management processes and to oversee the quality of the research, development and innovation activities carried out;
- Select high-potential R&D driven companies; provide state-of-the-art infrastructure, in a hassle-free environment at competitive costs to society.

pronouncement that has almost become emblematic for our times, Peter Drucker, arguably the most famous of management gurus, says, "Knowledge has become the key economic resource and the dominant – perhaps the only – source of competitive advantage". In the globalized world of today, redefining the parameters of a traditional economic system, a knowledge-based economy essentially emphasizes the use of ideas and technological resources, and relies greatly on innovation and education of workers who are capable of developing new skills to respond to the future challenges.

DoST has to play the role of a knowledge-led and knowledge-based organization, i.e. it has to transform itself into a knowledge-based organization. The creation of Knowledge Management Unit (KMU) is an important milestone, a decisive step towards steering the department to become a knowledge-led and knowledge-based organization. The Unit will manage knowledge flows to the point of use and protect intellectual assets from decay. It facilitates generation, sharing and use of knowledge and knowledge products through a "collecting" and a "connecting" approach. The 'collecting dimension' involves linking people with information. It relates to the

capturing and disseminating of explicit knowledge. The 'connecting dimension' involves linking people with people - specifically people who need to know with those who do know, and so enhancing tacit knowledge flow through better human interaction and communication processes, so that knowledge is widely disseminated and not just held in the heads of a few.

### 4.2 Creation of 'Ideas Bank'

The Ideas Bank is a place (preferably on the Internet) where people can post, exchange, discuss, and polish new ideas. Modalities are being worked out during the life of the project, especially in the initial phase. The program seeks to establish a repository of ideas and use 'Ideas as a Resource'. Besides being repository for information KMU can also be an 'Idea Bank'. Scouting for new ideas will be undertaken and in light of the prevailing relevant problems, ideas would be generated and solutions sought. The approach is to put ideas into products and business. The ideas generation exercises will be conducted in consultations with organizations in need of seeking solution to their problems. This will allow them to use their talent and contribute to the socio-economic welfare of the province. The Bank will also arrange shopping festivals.

### 4.3 Strengthening of Lab Teaching System

A programme has been designed on the lines that 'Science and technology education becomes a powerful means of developing attitudes of critical inquiry, respect for truth, simplicity, adaptability and systematic work, which are pre-requisites for initiating the process of social change and national development (Lewin, 1992)'. DoST has planned to mobilize scientists and research institutions to co-operate in programmes towards the development of school and college science lab teaching. Therefore, as part of the efforts to improve lab education in the province all relevant and interested organizations and institutions will be approached for technical and financial partnership/assistance/support for a national cause. The programme is based on demonstrating the importance of practical work in teaching of science, through capacity building of the labs in selected school and colleges, thereby bridging the gap between science as practiced and science in schools. It is aimed at fostering the development of scientific-reasoning and problem-solving skills based on experimentation and evidence evaluation in daily life. It is hoped that more use of experimentation in schools, a culture of scientific investigation and literacy will be developed, leading ultimately to increased production of new scientific knowledge in the province. Through the initiative model labs will be established, invigorated and strengthened through provision of required equipment, lab gear, audio visual support in repair of existing equipment and human resource development ensuring that precious government funds spent in establishing the labs are mobilized in the best interest of the public service. Model labs will also be established to demonstrate how to organize a lab on proper scientific lines.

### 6.4 Establishment of Cluster Level Quality Enhancement Laboratory

The laboratory will focus primarily on study of the commercialization of newly developed drugs, new formulations, new drug delivery studies, methods of analysis, stability studies etc. The establishment of a state-of-the-art quality enhancement/ research laboratory will not only help the pharmaceutical industry to boost the quality of the drug product but will also focus on R & D activities that will provide a platform over the entire chain of drug discovery and development. The lab will be a certification and authentication lab once it is registered with Food and Drug administration USA and/ or WHO. It will then have an international standing and would definitely help increase in export of pharmaceutical, food and chemical products. The lab is sustainable and would not be harmed by the closure of the project; it will generate revenue from the certification, authentication, tests, product development, formulations/ designing and from the appellate cases covering for the expenditure for the salaries of the staff, the working capital and O&M. For quite some times the need for a strong appellate lab has been felt. The lab can provide the opportunity for becoming the first one. The samples are sent to Pakistan institute of medical sciences for testing and analysis but there is no lab which can provide the facility of appeal against the tests and analysis of PIMS. This will also generate extra revenue for the lab. In case it becomes appellate lab then there will definitely be role for the lab.

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# THE IMPORTANCE OF BRIDGING THE GAP BETWEEN ACADEMIA & INDUSTRY

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**ABSTRACT**

*Industry requires development-oriented research work at universities, and universities require input from industry to define potential fields of problems requiring solutions. The industry and educational institutes of Pakistan need to formulate a strategy and set up a common forum, where industry-university interactions can result in real R&D work. A few steps have already been taken in this direction by top-class universities of Pakistan. For instance, Department of Electrical Engineering at COMSATS Institute of information Technology (CIIT) has established an Office of Industrial Liaison to have dedicated interactions with industry, spread awareness of the need of such interactions and explore the opportunities of mutual interests and benefits.*

*The mission of CIIT's Office of Industrial Liaison (OIL) is to build and nurture collaborative relationships between the Electrical Engineering Department of CIIT and industry. The huge resources of CIIT and industry combined can certainly set a right direction for innovation, technological advancement, skilled and qualified manpower, economy and many other social, moral and professional factors. On the other hand, industry is equally interested in joining hands with university, realizing the importance of such collaboration for sustainable growth. Industry-university collaboration funded by government agencies, will reduce the gap between the triaka. Today, the OIL at CIIT has started brainstorming, to come up with concrete guidelines for bridging the gaps between educational institutes, industry and policy-makers in Pakistan, which are reported in this paper.*

**Keywords:** CIIT, COMSATS, Development-Oriented Research, Unorganized industry, SMT, PCB, TechnoMoot, EMCOT, CEPEX, HEC

## 1. INTRODUCTION

Despite the glorious scientific achievements of the Muslims in the past, the Muslims of the sub-continent did not inherit much of the scientific fortune. At the time of its independence in 1947, Pakistan virtually had no industry and no educational institutes. The lack of visionary policy-makers and committed implementers has ever

since kept Pakistan in the shadows of ignorance, illiteracy and poverty. The ever-existing presence of refugees, whether they be from India, Afghanistan or any other country, has always preoccupied the minds of Pakistanis, at all levels and domains. A nation possessed with such factors could never make a plan for a better future for itself and, therefore, is still struggling for the basic necessities of life.

At the time of independence, Pakistan had engineers who could barely ensure smooth operation of railways, telegraph services, power distribution, canals, building and roads. These engineers lacked expertise in planning, design and development. After independence, this role of the engineers continued and its character has not improved much since then.

Indians on the other hand, realized that they required a different class of engineers for industry. They also realized that traditional engineering universities would require a long time to adapt to the new requirements and so in the mid 50's they established a new structure, namely Institutes of Technologies and started reaping its benefits by the 60's. On the other hand, the visionaries in Pakistan totally missed this point. The World Bank loans were obtained for setting up infrastructure, power-generation and transmission, railways, upgradation, telegraph (later re-designated as T&T) upgradation, airports, seaports and large-scale industries (particularly Textiles). All these were contracted on turn-key basis and no provision was made to involve the local engineers in the planning and design. This attitude persists even today.

## 2. SECTOR-WISE REVIEW

The textile sector felt that the type of engineers required for their operation and maintenance were not being produced by the conventional engineering universities. To fulfill their requirements, Textile Universities were set up. However, R&D is not actively supported even today.

During the period of the IT boom, a number of universities and technical institutes were set up, which offered degrees in computer science and computer engineering. The labs for the latter degree were not well-established. The teaching faculty was also not available. The formation of the Higher Education Commission (HEC) was a blessing for the Public- sector institutions, as it provided funds for the undergraduate labs. The HEC also undertook HR development and started sending students abroad for MS and Ph.D. The 9/11 incident resulted in a tremendous set-back for Pakistan's IT industry and the demand for IT graduates was drastically cut down. The universities changed their emphasis to Telecommunications, despite the shortage of faculty. There was a boost in demand for telecom engineers when the private sector was involved. However, due to inadequate lab practices, value-added jobs were lost.

The large-scale industry sets up plants on turn-key basis and needed engineers for operation and maintenance of such complex equipment that cannot be handled by the diploma-holders. Most of the large-scale industry only pays lip-service to indigenous

R&D. However, if the local R&D comes up with some idea/product design that saves money, they are most willing to take it up, of course, at nominal costs.

The medium-scale industry is always ready for advice from local experts, but they can not afford to fund R&D. These industries include fans and domestic appliances, plastic, chemical, pharmaceutical, auto spares and sports goods, etc. Their engineering requirements are generally adequately fulfilled by the diploma-holders.

The small-scale industrial sector is aimed at encouraging educated class of young entrepreneurs to develop industries in the core areas.

The so called unorganized industrial sector is the back-bone of Pakistan's industry. The automobile repair sector is manned by semi-literate auto-technicians and Kharadis (using lathes and drill machines); together they are keeping the automobiles running and saving billions of rupees per year. The large requirement for the lathe and drill machines prompted medium-scale entrepreneurs to indigenous manufacturing. The experts of Kotli Loharan, a small town in Lahore, have produced complex machines, like gear- hobbling machine.

Repair of electric motors, cheap plastic products, rubber products, and utensils-making are the sectors operated by semiliterate self-made technicians. All of these industrial sectors, discussed above, need guidelines for planning, designing and executing jobs. Special trainings and workshops need to be conducted for this un-organized industry. Universities funded by the government agencies can play a vital role in organizing this unorganized industrial sector.

During the last decade, education and general awareness has taken a leap forward in Pakistan. Thousands of Pakistani scholars are receiving higher education from the developed countries, across the world, and are returning to Pakistan to work for the betterment of their homeland. Many of these young scholars belong to the families of industrialists and educationists. Receiving an international exposure, with a chance to study developed societies of the world, enables these young scholars to join hands, visualize and bridge the gaps to some extent. University-industry relationships are being developed at various levels. These efforts, if sustained, will overcome the ever persisting problems of the industrial sector and of Pakistan's economy. Academia must realize that universities must lead industry for a sustainable development. The current scenario in Pakistan and most of the Muslim countries is the other way round and needs the special attention of policy-makers of the respective Muslim countries.

## 3. STRATEGY

There is a big gulf between the thinking of the academia in the engineering universities and the industry. Both entities are unable to understand the importance, requirement and benefits of mutual collaboration. The reasons for this gulf need to be studied, so that a viable mechanism could evolve. The industry requires engineers who can

undertake design and development, but the universities are not able to produce the required type of engineers. This is only because of the inadequate or non-existent interactions between universities and industry.

### 3.1 Innovation

Innovation is the life-blood of development. An organization's survival depends on the ability to nurture growth with a continuous flow of generative ideas. During the last few years, the government of Pakistan has taken some good steps with a futuristic approach, which will help in providing solutions to many national and international problems. The establishment of Technology Upgradation and Skill-Development Company (TUSDEC) in 2008 was a good initiative at government-level, to boost and spread the industry locally. TUSDEC will set up Common Facility Centers (CFCs) in Lahore and Karachi, to develop and promote the electronics industry so as to quickly reduce billions of dollars worth of imports of electronics and telecom gadgets, and would help the local industry to grow through 'economies of scale', by manufacturing and supplying sub-assemblies and kits at competitive prices [http://www.tusdec.org.pk]. The Lahore Electronics Complex is focusing on mobile phone and telecom sectors, the Karachi Electronics Complex will cater to the needs of consumers and home appliance industry, including the ones dealing in LCD (liquid crystal display), TV, computer monitors and multimedia products [http://www.opfblog.com/2324/electronics-complex-in-lahore-karachi-planned ].

These centres are targeted to house modern electronics design and quality-assurance labs, and will be equipped with hi-tech SMT (surface mount technology) machines for assembly of Printed Circuit Boards (PCBs), as well as high-volume automated assembly.

### 3.2 Research and Development

Research and development is required for national development and industrialization. Development-based R&D requires a strong liaison between universities and industry [Abubakar, B.A., pp 1]. However, in Pakistan and other developing countries, a wide gap exists between universities and industry; this gap between university and industry needs to addressed as quickly and safely as possible. During the twentieth century, developed and industrialized countries, like the US, realized the need to bridge the gap [Abubakar, B.A., pp 1]; the United States of America furiously worked towards building a close university-industry relationship in 1960s, and Europe and UK followed the precedent in the 1980s [Abubakar, B.A., pp 2].

### 3.3 Academia-Industry Linkages

The university-industry discussion normally produces vital opportunities for collaborative work, which is later taken up mutually for execution. If the identified work is of small scale and domain, then it is given to a group of

undergraduate/graduate-level students, under the supervision of a faculty member. If the work is of bigger scope and requires major R&D effort, then it becomes the responsibility of PhD scholars and senior faculty members. At least one expert from the concerned industry is involved in this type of R&D.

## 4. IMPLEMENTATION

The concerned authorities at CIIT have taken a few steps towards fostering university-industry linkages. The establishment of a dedicated office (OIL) under the umbrella of the Department of Electrical Engineering, for this purpose, is well-foresighted and planned accordingly.

As discussed earlier in this paper, the mission of the Office of Industrial Liaison is to build and nurture collaborative relationships between the Electrical Engineering Department of CIIT and the relevant industry. The considerable resources of CIIT and industry combined can certainly set the right direction for innovation, technological advancement, skilled and qualified man power, economy and many other social, moral and professional factors. In order to achieve its goals through proper implementation of strategies, the Office has started a few activities with the help of industry. The activities mainly are focused at seminars, workshops, industrial study-tours, process-analyses and problem-identification practice at industry, professional trainings in specific areas mutually indentified by industry, and R&D work at student and faculty-level. The idea is to produce "Work-Engineers" based on a continuous feedback from industry.

Secondly, CIIT must carry out development-oriented research work to feed the industry with innovation. The officials of the OIL visit small and medium-sized industry, to present the university-industry liaison proposal. Immediately after the first interactions, the experts from the industry are invited to visit CIIT in order to have a close discussion on the issue with the faculty members and students. The representatives from the industry are always interested in seeing the laboratory facilities of a university, so that they can estimate the type of work that can be done at the university's part. An engineering university, like CIIT, always has good laboratories equipped with most of the peripheral equipment required for R&D work. Industry is usually willing to provide any core equipment required for a specific R&D at the university. This kind of understanding between academia and industry opens the doors to R&D, skills, technological advancement and growth in overall economy of the country.

Figure-1 shows the working model of OIL. The Office of Industrial Liaison plays a pivotal role for university-industry interactions and relationship.

The intensive interactions with the local manufacturing industry has revealed that about 90% of the industry is using Siemens' control-systems and is facing a huge lack of trained engineers/manpower in this area. Engineers having know-how in this field

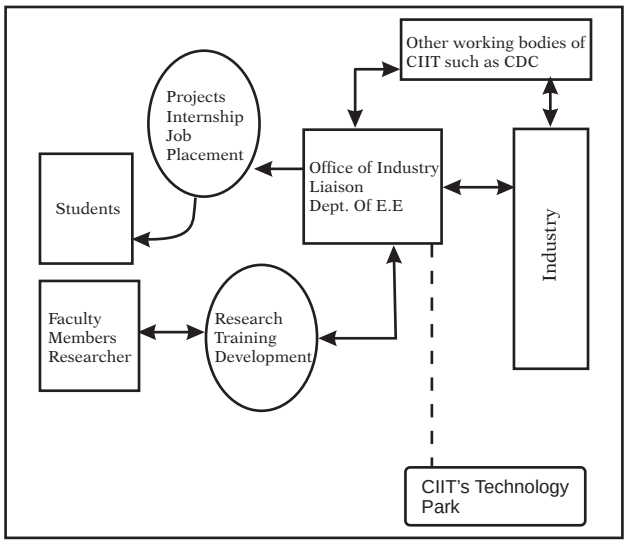


**Figure - 1: Working Model of O.I.L. at CIIT**

of expertise are readily picked up by the industry in the Middle East and, therefore, the local industry faces a set-back. Keeping the afore-mentioned facts in mind, the Office has discussed the scenario with the concerned authorities of Siemens (Pakistan) and they are willing to cooperate with CIIT. Siemens has offered CIIT their specialized training-equipment on the latest technology being used in the industry at special prices. The purchase of such equipment, alongwith trainings from the manufacturers, will give a tremendous boost to the quality and demand of CIIT's graduates. Similar understandings have also developed with a few local industrial units, to conduct professional trainings and certificate courses on various technologies, for which trained manpower is required by the industry. For this cause, CIIT plans to establish a Professional Training Center (PTC) under OIL.

CIIT holds its annual engineering students' project exhibitions, such as TechoMoot and EMCOT, at its Abbotabad campus. Now the Office has planned to hold an annual technology exhibition, namely CEPEX, at Islamabad campus, where industry, academia, students, professionals and policy-makers will be gathered at a single forum during this three-day activity [http://ciit-isb.edu.pk].

CIIT also plans a Technology Park within its premises, in the near future. This will provide a real-time industrial exposure to students while they are studying at CIIT. The academia and industry, linked together under one roof, can bring a revolution to a country's economy, living standards, as well as the academia and industry themselves.

## 5. CONCLUSION

It is imperative for engineering universities in developing countries, like Pakistan, to

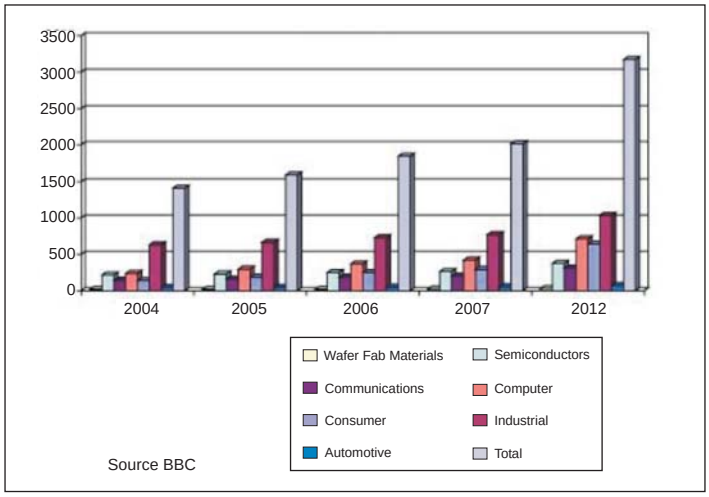


**Figure - 2: Global Sales of Electronics Products, 2004-2012 ($ Billions)**

find out the potential areas of development-oriented research. For this purpose, a close university-industry linkage is essential. Therefore, engineering universities in Pakistan and other developing countries must have a dedicated office with a highly professional and dedicated team for industrial liaison purposes. This office must have ample resources to conduct its responsibilities efficiently.

CIIT's Office of Industrial Liaison will be industry's one-stop shop for CIIT expertise. The vast resources of CIIT can provide a rich vein of technological and managerial innovation that will help sustain industry's competitive advantage for decades to come.

According to a report by BBC, the global sale of electronic product has a huge impact on the world economy. Figure-2 shows the growth of electronic consumer products globally. By 2012, it is expected to reach US$ 3.2 trillion annually. Developing countries like Pakistan must focus on this market segment and start establishing industry of electronic consumer- products at a fast pace, in order to have their share in this rich and ever-growing segment of electronic products.

One suggested solution would be to task the academia to single-handedly meet the challenge with a missionary zeal. The Department of Electrical Engineering, Electronics and Physics, Mathematics, Material Sciences, Management Sciences and allied faculties at universities of developing countries should prepare and implement a unified strategy, keeping in view the global requirements given in Figure-2. The annual global requirements, by 2010, of passive electronic components will reach US$ 169 billion; Semiconductors at US$ 444 billion, Connectors at US$ 40 billion and electronic consumer products at US$ 1.9 trillion [http://www.electroline.com.au].

Universities must focus on the development of entrepreneurship in the students and review the courses, laboratory practice and project work, so that the graduating engineers are immediately and gainfully employed by the industry.

R&D must be industry-specific according to the local technology absorbing capacity. The concerned authorities at universities need to locate relevant industrial units and participate and educate their projects directly or indirectly.

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# USE OF RENEWABLE ENERGY IN THE IMPLEMENTATION OF 'CLEAN DRINKING WATER FOR ALL' (CDWA): PROJECT FOR HEALTH BENEFITS, JOB CREATION AND LOCAL OWNERSHIP

**Ali Kamal**
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**ABSTRACT**

*The mortality rate for children under-five in Pakistan from diarrheal diseases is among the highest in the world. The USAID-funded Pakistan Safe Drinking Water and Hygiene Promotion Project (PSDW-HPP) is implementing a series of interventions to achieve a reduction in the incidence of diarrhea, through access to safe drinking water and improvement in hygienic practices. The Ministry of Special Initiatives (MoSI) of the Government of Pakistan (GoP) is implementing Clean Drinking-Water for All (CDWA) project at a cost of over Rs. 20 billion, by installing 6,626 drinking-water filtration plants in all the Union Councils of the country. CDWA is a follow-on or expanded version of the earlier Clean Drinking Water Initiative (CDWI) project, executed by the Ministry of Environment (MoE), with the mandate of installing one drinking water filtration plant in each Tehsil of the country for a total of approximately 445 plants. This paper highlights various aspects of the PSDW-HPP that has an integrated scope for capacity-building and employment- generation.*

## 1. INTRODUCTION

Pakistan Safe Drinking Water and Hygiene Promotion, a USAID funded project, was started under a Memorandum of Understanding (MoU) between the MoE, Pakistan, and USAID signed in 2006, to support the CDWI in selected districts. The main objective of this project is to safeguard the investments made by GoP in an effort to provide safe drinking- water to the people, by creating an enabling environment through Behaviour Change Communication (BCC) in hygiene and sanitation, community mobilization and enhancing access to sustained safe drinking-water systems in the target communities. PSDW-HPP has worked around the CDWI plants in 28 Districts, 6 Federally Administered Tribal Areas (FATA) agencies and 6 Frontier Regions (October 2006 to March 2010). As a continuation of USAID support to the GoP on Clean Drinking Water Projects and through the implementation of PSDW-HPP, the USAID and MoSI signed another MoU in 2008 to collaborate further through this

platform. PSDW-HPP, based on the lessons learned from its experiences with the CDWI plants, suggested various corrective measures for the success of the larger initiative (installation of over 6,000 plants) at several locations and shared these with the MoSI. However, the transition and experience of moving from CDWI to CDWA was not very smooth and a number of shortcomings in the approach, methodology and implementation-mechanism were faced by the implementation agencies, thus necessitating shifting the responsibilities for implementation from MoE to the Ministry of Industries, Production and Special Initiatives (MoI, P&SI), and finally to the newly created MoSI.

The USAID-PSDW/HPP baseline-survey results indicate that only 7% of the households in the districts treat the drinking water effectively and as many as 71% of the households in treatment-districts believe that if the water is clear, it is safe to drink. In addition, only 51% of the households had soap, thus suggesting poor hand washing.

This concept-paper of the project is to address a request by the MoSI to USAID PSDW-HPP to provide technical assistance in support of the implementation of the Clean Drinking Water for All (CDWA) Programme (See Figure-1). This technical assistance will consist of the implementation of integrated activities that support and complement the installation of filtration plants under the CDWA programme. The technical assistance in the initial phases will be focused on 26 districts and FATA, which are priority for USAID and where approximately 1,000 plants are located. USAID PSDW-HPP is implementing the project in 6 agencies in FATA, 6 Frontier Regions, and 28 districts, of which 8 are within the 26 focus districts mentioned above. The integrated approach builds upon the experiences from implementation of the USAID PSDW-HPP and the review of the problems encountered that prevented more than half of the 445 plants initially installed by the Government of Pakistan from becoming fully functional. The approach focuses on activities to enhance local capacity and ownership to operate and maintain the plants, and use of solar energy to power the plants resulting in skill-development and job creation at the local level. Behaviour change communication (BCC) on safe water-handling and proper hygiene and sanitation practices, and promotion of household technologies for water-treatment will continue to be important and necessary components to complement the GoP investments in water-infrastructure to achieve reductions on diarrhea. To this end, the PSDW-HPP is also supporting the Ministry of Environment in the development of a National BCC Strategy, which builds upon the experiences in the implementation of the PSDW-HPP BCC strategy.

## 2. EXPECTED RESULTS OF PSDW-HPP

The following are expected results from the implementation of these activities:

- *Health benefits:* Access to Safe Drinking Water: Enhancing access to safe drinking-water, through 1,000 filtration plants operating in 1,000 Union Councils of Pakistan, and creating awareness and behaviour change communication in water-

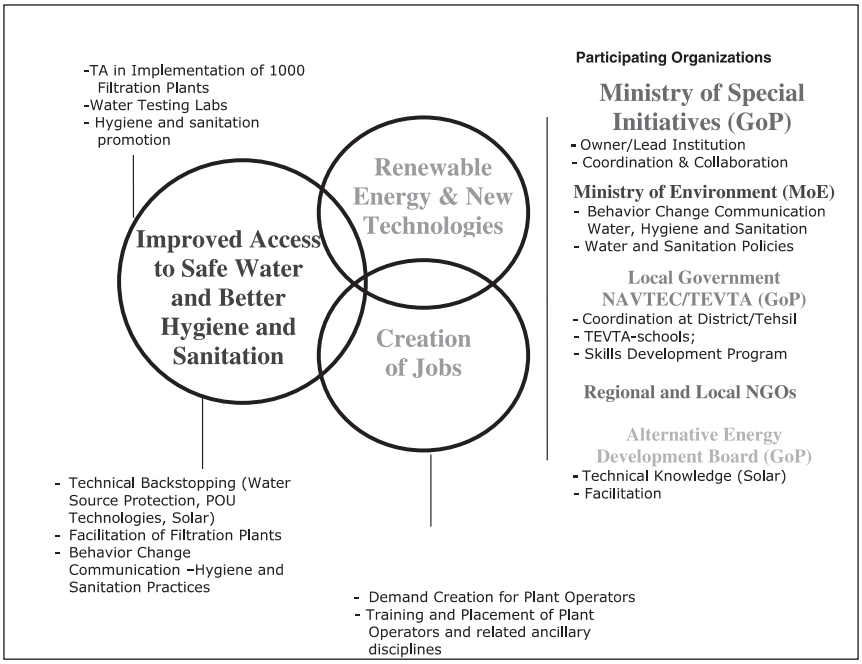


**Figure - 1: Conceptual-Chart of an Integrated Cross-Sectoral Project**

use, and hygiene and sanitation practices among the communities will directly impact the infant mortality-rate, due to diarrhea reduction, one of the largest killers of children under the age of five. Roughly, a population of over 40 million will be benefited in the USAID priority areas in 26 districts and FATA.

- *Job creation:* 15,000 jobs will be created in the first two years in 26 districts and FATA for youth and women, who will assemble the solar units and provide post-installation maintenance. In subsequent years, more than 100,000 jobs will be created all over Pakistan.

- *Alternate energy usage:* To address Pakistan's energy shortage, solar panels would be utilized, creating a substantial requirement for assembly, installation and maintenance operators that could attract private investment and stimulate the emergence of a market for renewable energy, equipment and services. Public-Private Partnerships and close association with GOP's AEDB will become another integral component of the project.

- *US branding at grass-roots level:* US solar technology will be introduced on a large scale in Pakistan. Concurrently, USAID will be able to project an unprecedented "face" at the grass-root level in Pakistan. Apart from the USAID branding, the plants can be further branded as "Powered with the support of the American People".

**Table - 1(a): Conceptual Impact of Integrated Cross-Sectoral Project Phases I and II (1,000 plants)**

| 1. | PRIMARY IMPACT | Activity | Partner | Immediate (Sept-2009-Mar-2010) | Follow-Up (Mar 2010-Sep 2011) |
|---|---|---|---|---|---|
| 1a | Health Impact/ Access to Safe Drinking Water/ BCC | Original Commitment of PSDW-HPP – 93 CDWI Plants in 26 Districts | Local NGOs in 26 Districts | Targeting 15% of 40 Million Population | Targeting a 40 Million Population |
| 1b | Youth and Women Training Scheme | Training of Operators for Filtration Plants;<br><br>Training of Water Lab Technicians & On-Site Technicians;<br><br>Training of Solar Panel Operators & Technicians; | TEVTA; NAVTEC; Local Govt. at District & Tehsil Level Local NGOs | 1,500 beneficiaries<br><br>300 beneficiaries<br><br>450 beneficiaries | 8,500 beneficiaries<br><br>1,700 beneficiaries<br><br>2,550 beneficiaries |
| 1c | Technology Implementation | Water Accessibility; Water Source Protection; Renewable "Green" Solar Technology Implementation | AEDB; Private Sector; TEVTA; NAVTEC; Local Govt. at District & Tehsil Level; Partner NGOs | 300,000 beneficiaries | 1,700,000 beneficiaries |

**Table – 1(b): Phase III (5,000+ plants)**

| 2. | SECONDARY IMPACT | | | Post 2011 |
|---|---|---|---|---|
| 2a | Skill Development & Enhancement | - as above - | TEVTA; NAVTEC; Local Govt. at District & Tehsil Level | 100,000 beneficiaries |
| 2b | Green and New Widespread Technology Implementation/ Attracting Private Sector Interest | - as above - | TEVTA; NAVTEC; Local Govt. at District & Tehsil Level | 1 million beneficiaries |

- *Broad-based partnership:* Diverse array of partners will implement this initiative, including MoSI of GoP, which will be directly responsible for procuring the solar units, provincial and district governments (Tehsils Management Authorities-TMAs, and Technical Education & Vocational Authority - TEVTA) to manage the filtration plants and training the youth and women, USAID, US private-sector

firms providing solar technologies, Pakistani private-sector firms, and local NGOs for advocacy and demand creation.

- *Local Ownership:* The bulk of the resources (80%) will be spent through the local partners in procuring the solar units and training the relevant staff to maintain the plants. USAID will provide the coordinative and technical lead, as well as the local capacity-building, community-mobilization and complementary awareness and behaviour-change communication in water, hygiene and sanitation.

- *Implementation of the National BCC Strategy:* Implementation of BCC activities for water, hygiene and sanitation, according to the newly developed BCC strategy supported by the USAID PSDW-HPP.

## 3. PROJECTS COMPONENTS

MoSI has requested technical assistance from PSDW-HPP in implementing CDWA. This abstract addresses the areas of technical assistance requested by MoSI in implementing CDWA, with main focus on the following:

- Provision of awareness-campaigns for use of safe water, and hygiene and sanitation behaviour-change communication;
- Technical assistance in monitoring the installation of the plants;
- Local capacity-building and community-mobilization for sustainability of plants;
- Develop and deploy solar energy technology for sustainable, affordable operation of 1,000 plants in the USAID priority districts and FATA;
- Extensive trainings and job-creation for thousands of locals: technical expertise in water-testing, plant operation and maintenance, alternate technology/solar power conversions.

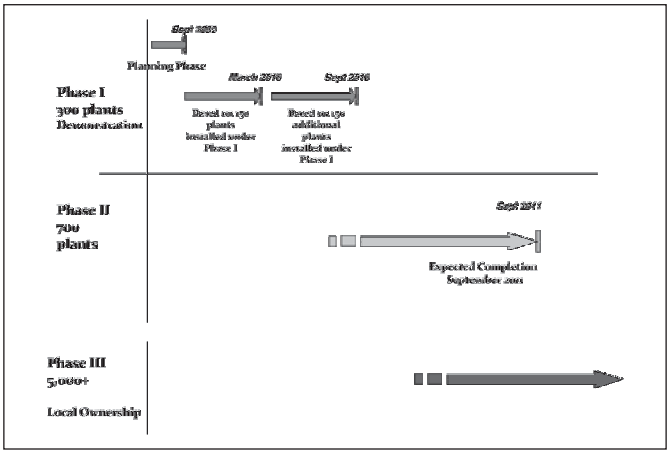


**Figure - 2: Proposed Implementation Schedule**

## 4. IMPLEMENTATION PLAN

The technical assistance for the aforementioned components will be carried out in phases, in alignment with the implementation of USAID programmes, which are focused on 26 districts and FATA. USAID will initially provide technical assistance for Phases I and II, as shown in the figure below, in support of the installation of 1,000 plants in these districts. Specific geographical areas for implementation of activities will follow construction- schedules, in coordination with the CDWA programme implementing units.

## CONCLUSIONS

The technical assistance provided, as mentioned above, will have positive impacts in health, energy conservation, and employment generation. The operation of 1,000 filtration plants demand skilled and trained technicians, not only to operate and maintain these plants but, also, to conduct water-quality testing. Training youth and women to develop skills in water-testing, operation and maintenance, and behaviour-change communication would become a core component. Partnership with government agencies, like National Vocational & Technical Education Commission (NAVTEC) and TEVTA, as well as the local governments, CBOs, and NGOs, would become a component of the project, thereby imparting trainings and generating jobs.

# CHANGING ROLE OF UNIVERSITIES IN KNOWLEDGE ECONOMY

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**ABSTRACT ONLY**

**ABSTRACT**

*Knowledge has always been the key driver for development of any society and the universities are the fundamental source of knowledge-creation and application of knowledge for resolution of problems being faced by the society, thereby moving the economic cycle of the nation. The developing countries have long been suffering from lack of will, as well as intellectual training, to be able to benefit from such opportunities. The genuine and honest effort from troika of university, industry and government can result in a successful model of economic development, as evident in the cases of Malaysia, Korea, Israel and, to a lesser extent, in other developing countries as well.*

*The educational system, as a whole, in developing countries has suffered from lack of creativity and activity-based learning. Major focus stays on teaching specific books/notes (extracts from books) with more emphasis on memory-skills (rote learning) than on developing analytical skills. Such practices kill creative ideas and thinking-skills among students. On joining university, their focus on studies is hardly any different, because the professors in universities have very little exposure to the industry and mostly research is also more focused on theoretical domain of knowledge than on application to the real-life problems of the society. This is now changing steadily with the advent of Information Technology and their integration with sectors of the National Economy, to produce a Knowledge-based Economy.*

# PANEL DISCUSSION
# AND
# CONCLUDING CEREMONY

# PANEL DISCUSSION AND CONCLUDING CEREMONY

## PANEL DISCUSSION

The Concluding Session of the Seminar was preceded by a panel discussion session, wherein all subject-experts deliberated thoroughly on the challenges and solutions relevant to their fields. The following theme-wise recommendations and observations were made:

## THEME-WISE RECOMMENDATIONS

The recommendations made by the speakers and participants of the event, during the course of 6 technical sessions of the seminar, are summarized below:

### 1. Renewable Energy Technologies

1.1 The following considerations are important for creating employment opportunities in the field of renewable energy:

- Development of R&D infrastructure in renewable energy sector will open avenues for research institutes, organizations, departments and the laboratories of private sector to initiate research activities.
- Support to renewable energy initiatives, by both the public & private sector enterprises, to be weighted in the light of the following observations:
  - The sector is still in its infancy and lacks adequate human resources;
  - A large number of professionals is still required to support planned initiatives.
- Renewable energy sector can be developed by supporting the manufacturers of:
  - Wind Turbine Towers & Accessories;
  - Turbines & Generators (wind, hydro, steam, gas);
  - SHS and Solar PV Panels;
  - Solar-thermal appliances, for both active and passive applications; and
  - Commercial, residential and industrial lighting-solutions, through solar and wind energy.

*[Mr. Irfan Yousuf, Deputy Director (CDM), Alternative Energy Development Board, Government of Pakistan, Islamabad]*

1.2 Development of renewable-energy projects will provide energy-security, as well as offer tremendous employment-opportunities in the country. There is a need to:

- Launch an intensive undergraduate research degree programmes for producing experts and scientists in renewable-technology areas;
- Initiate certificate and diploma programmes in specific areas of renewable energy for training technicians;
- Enhance awareness for the renewable energy applications among various stakeholders, industrialists, entrepreneurs, policy-makers and the general public;
- Encourage and facilitate entrepreneurs to develop trade and investment relations with partners in other parts of the world, particularly with countries, like Australia, Canada, Europe, Japan, US, Denmark, Norway and Sweden, operating well-established programmes ;
- Initiate small and large demonstration-projects in rural areas, contributing towards development and poverty reduction;
- Devise policies for ensuring the mitigation of environmental impacts associated with the use of fossil-fuels and unsustainable fuel supplies.

1.3 The importance of simple technologies, like solar thermal, windmills, biogas, hydroponics, for socio-economic development should be recognized, and small institutes should be established to impart one-year training to selected students, after their intermediate-level education (e.g. after F.Sc). The trained students should then be supported by businessmen venture capitalists to start manufacturing at small-scale in these disciplines.

*[Prof. Iftikhar Ahmad Raja, Department of Environmental Sciences, COMSATS Institute of Information Technology, Abbottabad]*

1.4 Most of the developing countries lie in the geographic latitudes that have high solar insolation. This advantage needs to be fully exploited. Solar-thermal energy for space and water heating is a simple affair, which requires only low-cost storage-capacity. It could be seen as an energy solution with a big job-market potential, as: it is low-cost and more efficient; involves no foreign exchange; and, the discharged steam can do other jobs, such as space heating, and space cooling.

*[Mr. Waqar Haider Bokhari, Advisor R&D Lab, COMSATS Institute of Information Technology (CIIT), Islamabad]*

1.5 Solar-Home Systems (SHS) in rural Balochistan may result in improving socio-economic conditions, as well as generating a need for employing technicians to handle such systems. Following are some of the benefits of Solar Home Systems:

- Development of favourable socio-economic conditions in the rural area;
- Development of cottage industries;

- Creation of awareness about renewable-energy sources; and
- Promotion of the use of environment-friendly solar energy.

*[Mr. M. Khalil Khetran, Alternative Energy Development Board, Regional Office Quetta, Balochistan]*

1.6 Development of household wind-electricity generating units could lead to employment generation. Skilled and trained manpower is the key to develop such projects. A group of engineers and economists should be consulted to prepare training-modules on wind-electricity generating units. COMSATS should organize training workshops in the field of wind-energy, keeping in view the following:

- Owners and technical workers of the fan industries should be sensitized and trained;
- Entrepreneurs in the wind-energy field should be provided the necessary training on priority basis;
- Participants should be given technical hands-on training with the help of engineers, so as to enable them to actually design and develop wind turbines;
- Teachers of engineering universities should also be given a fast-track refresher course;
- Teachers of polytechnic colleges should be given compulsory training;
- Daily subsistence allowance should be provided to all the participants who have left their jobs for the training;
- If possible, the training should be arranged in Gujranwala and Gujrat (key fan-industry areas of Pakistan) for better participation;
- COMSATS, in collaboration with the pertinent government body should provide funding to engineering and polytechnic institutions for R&D;
- Trained manpower could be employed in the above-mentioned activities at various stages of fabrication, installation and maintenance.

*[Dr. Syed Tahir Hijazi, Professor, Faculty of Management Sciences, COMSATS Institute of Information Technology, Islamabad]*

1.7 In order to encourage the industrial and commercial activities in the emerging field of wind-energy technology, the following recommendations are made:

- Exemption on import duties, custom levies and other fees/charges may be continued/maintained for at least the first ten years of the technology induction;
- Tax holidays, in terms of sales tax, income tax and all other taxes, may be granted for a similar period, to encourage investors;
- Land should be leased on easy terms in the industrial areas for manufacturing concerns, just as it is being leased for wind farms;
- Use of a certain percentage of green energy (wind/solar/biomass, etc) in the

total energy being used by industries may be made compulsory, so that investment in these green energy technologies increases.

*[AVM (R) S. J. Raza, CEO Dawood Power (Pvt) Ltd, Karachi]*

1.8 The following measures/steps could help create more jobs and enhance the available number of employment in the bio-ethanol production sector:

- Export of molasses should be banned immediately;
- Blending of ethanol with the conventional fuels for all the vehicles should be started without any further delay;
- Incentives in the form of tax reduction and excise duty exemption should be given.

*[Mr. M. Arshad, Chemist, Ethanol Division, Shakarganj Mills Ltd., Jhang]*

1.9 Use of Biogas (Natural Gas) can provide Pakistan with a viable source of energy-production and result in creation of employment in rural areas of Pakistan. Adoption of the simple technology by the livestock-owning households can increase the income of the poor rural communities, besides increasing organic production.

- Organic agricultural products can reduce the health-bill of the rural communities and, thus, help in promoting sustainable production and consumption. The decentralized (biogas) energy production-units can bring self-sufficiency to the rural households, save forests; provide organic fertilizers to the soil, increasing its fertility, besides mitigating the environmental pollution;
- The Government of Pakistan, local and international donor agencies interested in poverty alleviation, decentralized alternate energy development and rural development may look into tapping this huge potential of alternate energy, so as to relieve Pakistan from its energy crises and bring prosperity to the communities living in rural areas of the country.

*[Dr. Muhammad Khurshid, Deputy Secretary, Economic Affairs Division, Government of Pakistan, Islamabad]*

1.10 The following observations are made for employment generation through energy conservation techniques in the steel industry:

- Energy consumed in local steel industry is being wasted due to the use of inefficient processes. When pre-heated air is used for combustion in furnace, it can result in conservation of 40% fuel. When cost is converted into monetary terms, it results in a sizable profit for the foundry. Energy

saved can then be used to open up new industries that will provide job opportunities to more people.

*[Dr. Ahmad Sohail, Asstt. Professor, College of E&ME (NUST), Rawalpindi]*

## 2. AGRICULTURE & BIOTECHNOLOGY

2.1 The efficient utilization of indigenous coal reserves will enable the country to reduce the oil import bill, which amounts to about US$ 4.0 to 4.5 billion. In this context, the following observations are made:

- Microbial desulphurization has the potential to save US$ 7 per tonne with respect to hydro- and fuel-gas desulphurization;
- Currently, in Pakistan imported coal is available at the landed cost of US$ 180 per tonne, as compared to the local cost of US$ 103 per tonne. Keeping in view the total landed cost of imported and local bio-treated coal almost US$ 70 per tonne can be saved, which makes a handsome amount in the form of huge sulphur-coal reserves of Pakistan; Coal biotechnology, which is at the verge of commercial upscaling, has large potential in Pakistan, in terms of employment-generation for people having different levels of skills and education; and
- Implementation of coal biotechnology based projects must be included in the national long-term policies, in order to boost the national economy by utilizing indigenous energy-resources, and reducing the oil and coal import bills of the country.

*[Dr. M. Afzal Ghauri, Industrial Biotechnology Division, NIBGE, Faisalabad]*

2.2 An effective policy framework is urgently needed to address issues of sustainable agriculture, and related production units that would help generate employment-opportunities. This could be achieved through promotion of:

- Livestock farming (enhance existing livestock-production, through various technologies);
- Organic farming; and ecologically compatible cropping system.

2.3 In order to have a strategic plan of action to develop the food industry and related employment-generation, the following are important:

- Gap/SWOT analysis of the food industry to identify requirement, local production capability and capacity;
- Assessment of employment-potential of various units;
- Facilitation of local-foreign partnerships;
- Selection of feasible high value-addition technologies that support employment;

- Identification of all the potential stakeholders;
- Timely involvement/participation of the stakeholders in the national development projects/initiatives;
- Availability of a sound infrastructure;
- Development and promotion of the cluster concept, e.g. clusturing of industrial units at one location near the source of raw materials;
- Reinforcement of confidence-building measures for the entrepreneurs.

*[Mr. Abdul Mannan Usmani, Deputy General Manager, Shan Foods, Karachi]*

2.4 The marginalized communities usually depend on forests for a larger share of their overall livelihood needs. Forest products based activities can be particularly beneficial to women because many such activities can be combined with their household tasks. Ease of access to the resources, and low skill and capital thresholds to commercial forest-product activities mean that these can prove very important in coping with the needs of the poor. This may be facilitated by:

- Joint collaboration in future projects of different NGOs, government agencies, etc;
- Establishment of linkages among different stakeholders;
- Capacity-building;
- Holistic Natural Resource Management (NRM) Programme, for example identification of key mutualisms for management.

*[Dr. Zabta Khan Shinwari, Quaid-i-Azam University, Islamabad]*

## 3. INFORMATION AND COMMUNICATION TECHNOLOGIES (ICTS)

3.1 Some of the important steps to be taken for generating employment in ICT sector are:

- Conducting adequate market and feasibility studies for having commercially viable projects;
- Upscaling ICT projects;
- Building the skill level of staff providing modern equipment and laying latest infrastructure;
- Assigning definite time-period for the implementation of ICT based project; and
- Creating networking with well-established research institutes.

3.2 ICTs have the potential to generate numerous employment-opportunities for young people. However, this potential will be effective only when the country has a range of supporting strategies in place, including an enabling environment. Effective and proven policy-measures can be formulated to meet the employment-needs of every developing country, like Pakistan, where unemployment ratio is

increasing exponentially.

3.3 Introducing ICTs in education is the key to provide young people with ICT skills. Therefore, the government needs to run more projects for education. The participation of young people in the development and implementation of initiatives involving the use of ICTs is a must. Support to start up ICT-based enterprises is a key service that governments, private sector, multinationals, NGOs or international organizations could provide to the young entrepreneurs.

*[Dr. B. S. Chowdhry, Directorate of IICT, Mehran University of Engineering & Technology, Jamshoro, Pakistan]*

3.4 ICTs, if supported with the right policies and with cross-cutting and holistic approaches, could complement and strengthen other multi-sectoral efforts that are required for creating jobs, resulting in economic growth.

*[Mr. Iqtidar Zaidi, President & CEO, Tech Access Pakistan, Islamabad]*

3.5 Unemployment can be reduced among youth and female population, by laying a proper ICT infrastructure and imparting IT related skills. There is a need to initiate and progressively improve the economic opportunities relating to ICTs through cyber organizations in rural areas.

*[Dr. Nazir A. Sangi, Professor, AIOU, Islamabad]*

## 4. ENVIRONMENT

4.1 In order to more effectively implement the existing national environment policy, the following are urgently needed:

- Transition of Pakistan's economy to an ecologically sustainable one, where long-term stable employment-opportunities could exist;
- Strategies to provide safe, meaningful, and environmentally and socially beneficial employment for all who wish to work;
- A commitment by the Government towards providing: vocational and training facilities; incentives for private enterprises to create more job-openings; and support for weaker and under-privileged segments of population;
- Professional vocational training facilities in the field of environment that would lead to more employment-opportunities for people to be able to work as skilled workers for the local industry.

4.2 Pakistan is blessed with the highest peaks, mighty glaciers, vast deserts, beautiful valleys and archeological sites. The need is to exploit these resources to attract international tourists. The following steps may help to enhance ecotourism; that in turn can contribute to the national economy and employment generation.

- Allocation of more funds and other resources for the protection and development of the areas that need to be preserved. Such development activities should be labour-intensive to provide job opportunities, particularly to the local inhabitants; Expansion of cultural tourism in specific areas, resulting in greater employment opportunities for the local people;
- Effective environment policy could result in large number of new job opportunities if it is carefully implemented. Green construction – building of environment-friendly and energy-efficient structures – can help in generating employment in new materials, and energy-efficient technologies.

*[Dr. Khalid Farooq Akbar, Associate Professor, Department of Environmental Sciences GC University, Faisalabad]*

4.3 Community-based sustainable projects can help in creating green jobs and may also lead to environmental protection. Such projects/initiatives may include the following:

- Green Construction;
- Public-sector transport, with mass-transit systems; and
- Improvement of resource-use efficiency of existing buildings.

*[Ms. Iffat Ashraf, Department of Environmental Sciences, GC University, Faisalabad]*

4.4 It is imperative for sustainable development to have timely and up-to-date information for the policy-makers in the key areas for quick decision-making. Remote-sensing can provide consultancy solutions, and shape future trends in the areas of climate-change, hydrology, snow and ice, agriculture and forest, oceanography, land-use and land-cover, as well as geology, for the impact assessment, weighting of mitigation options and adaptation of a host of relevant mitigation technologies.

*[Dr. Mohsin Jamil Butt, CSHR Group, Department of Meteorology, CIIT, Islamabad]*

## CONCLUDING CEREMONY

The Concluding Ceremony of the National Seminar was held on 12th August 2009 at COMSTECH Secretariat, which was attended by the principle organizers (the then Advisor COMSTECH, Dr. Anwar Nasim, and Director General (International Affairs) COMSATS, Mr. Tajammul Hussain), besides many others. Dr. Nasim commended the speakers for their elaborate presentations and valuable inputs during the two-day Seminar. He encouraged the speakers and participants to form an active network and follow-up on the recommendations of the seminar. Mr. Hussain presented a vote of thanks to the speakers and participants and also invited them to make intellectual contributions towards COMSATS' scientific programmes and activities.

Dr. I.E. Qureshi, Executive Director COMSATS, awarded certificates of participation to the speakers and participants at the end of the ceremony.

**Glimpses of Panel Discussion Session and Concluding Ceremony**

# GENERAL RECOMMENDATIONS AND CONCLUSIONS

# GENERAL RECOMMENDATIONS AND CONCLUSIONS

- The role of government for employment generation in various fields of science and technology should be strengthened through dialogues among policy-makers, industry and academia. The implementation of relevant policies should be closely monitored.

- Efforts should be made to reduce the communication-gap between central, provincial and local governments and for effective coordination of national-level programmes and projects.

- Successful implementation of development initiatives, such as employment-generating programmes, chiefly require a paradigm shift, which can be brought about by sensitizing people to the need to change. It also requires a strong political will and capable leadership with a vision to promote 'conceptual economy'.

- An interdisciplinary mode of working should be adopted at all levels and the networking/sharing/coordination mechanisms must be improved. Employment-generating programmes should be developed through an integration of various stakeholders, including policy-makers, members from academia and R&D circles, as well as, industries and private sector.

- In order to have mass employment-generation through institutional arrangements, focus should be on attracting venture capital. The Government, with the help of the private sector should focus on institutional development, making provisions for endowment funds, developing competitive markets, and encouraging financial venture capital.

- Industry-academia linkages should be promoted.

- Targeted research should be promoted that leads to developmental projects having an integrated feature of employment-generation for the masses.

- Government agencies and academia should initiate the process of building sector-wise databases on availability and capacity of skilled and semi-skilled human resources, which should be upgraded periodically for improved and effective policy-making and planning.

- The entire system of education in the country needs to be reviewed and improved, so as to nurture the ability of developing the right skills in young minds for producing professionals, as well as to synchronize the system with the future job-requirements.

- Lop-sidedness of job-opportunities in the urban and rural areas of the country should be addressed through initiation of income-generating projects and programmes in peri-urban and rural areas. Particularly, there should be a special focus on employment-generation at the village level. In this regard, grass-root level participation should be encouraged for identifying the training and work-related needs, and planning and executing the policies/programmes.

- Efforts should be made to enhance the intellectual capacities of policy-makers through trainings and networking with the think-tanks.

- The Government should ensure an enabling environment for research, investment, entrepreneurship and public-private partnership. Effective implementation of government policies that ensure financial commitments and encourage investment can help in generating employment. Initially, pilot-projects should be developed by the government that, if successful, may be replicated and scaled up in coordination with the private sector.

- Lessons should be learnt from Japan and South Korea viz application of reverse-engineering model to improve their national productivity and economy.

- The Government should make provisions of seed-money for initiation and promotion of R&D. Incentives should be given to the private sector, and appropriate investments must be made in the emerging fields of science and technology.

- Emphasis should be laid on local resource development and conservation.

- Innovative entrepreneurship by means of networking of entrepreneurs and their participation in the developmental activities should be promoted.

- A shift in focus must be made from 'produce' to 'products'. The four parameters that must be taken into consideration are: quality, cost, innovation and speed.

- Local people should be involved in setting up new projects/sectors/industries. Project/business feasibilities should be worked out by pertinent government bodies and provided for guidance/use to the entrepreneurs/private-sector at cost-basis.

- Private sector needs to be sensitized to the need to take initiatives in order to support the government's development activities.

## CONCLUSIONS

The proceedings of the two-day Seminar included comprehensive presentations on a set of appropriate and economically viable technologies having potential for future economic growth and employment generation in Pakistan. A critical review of the existing policies, strategies and programmes relating to employment-generation was made, and case-studies of successful strategies companies/projects in Pakistan that have resulted in job-creation for the masses were presented.

The Seminar called for integration of various technologies, capacity building of R&D institutions, and involvement of industry members and policy-makers, in order to generate sustainable livelihoods for the masses. The promotion and facilitation of innovative entrepreneurship, interdisciplinary mode of working, revitalized political will, freedom of movement of capital, and an enhancement in the intellectual capacities to formulate effective policies, were deemed necessary to obtain sustainable generation of employment in a meaningful manner. There is a need for revisiting the current policies, through the involvement of all the stakeholders of the society at every stage of the decision-making process. It was noted that sustainable employment-generation is an important macro-economic indicator of development; however, it should not be considered the responsibility of the government alone, but the academia, industry and the private sector also need to play their due role in this connection.

The outcome of the Seminar was a set of concrete proposals and recommendations from the subject-experts, highlighting the best practices and technologies having the potential to uplift the socio-economic status of the country by creating large-scale employment opportunities for people of all skill-levels. The Seminar also served as a platform for the establishment of contacts among subject-experts, scientists, technologists, scholars, policy-makers, entrepreneurs and students, for future interaction and follow-up actions on the recommendations of the Seminar.

# ANNEXURES

**Annexure - A**

# LIST OF SPEAKERS

1. **Dr. Iftikhar Ahmad Raja**
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2. **Dr. Khalid Farooq Akbar**
   Associate Professor
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   GC University
   Faisalabad

3. **Ms. Iffat Ashraf**
   M.Phil Scholar
   Department of Environmental Sciences
   GC University
   Faisalabad

4. **Dr. Mohsin Jamil Butt**
   Climate Snow and Hydrology Research Group (CSHRG)
   Department of Meteorology
   COMSATS Institute of Information Technology
   Islamabad

5. **Dr. Muhammad Khurshid**
   Deputy Secretary
   Economic Affairs Division
   Government of Pakistan
   Islamabad

6. **Dr. Ahmed Sohail**
   Asst. Professor
   Director National Solar Lab.
   College of E&ME, NUST
   Islamabad

7. **Dr. Syed Tahir Hijazi**
   Professor
   Faculty of Management Sciences
   COMSATS Institute of Information Technology
   Islamabad

8. **Mr. Mohammad Khalil Khetran**
   Director
   Alternative Energy Development Board (AEDB)
   Quetta

9. **Mr. Irfan Yousuf**
   Deputy Director (CDM & Environment)
   Alternative Energy Development Board (AEDB)
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10. **Prof. Waqar Haider Bokhari**
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    COMSATS Institute of Information Technology
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12. **AVM (R) S. J. Raza**
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    Dawood Power (Pvt) Ltd
    Karachi

13. **Dr. Zafar Altaf**
    Former Chairman
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    Islamabad

14. **Dr. Zabta Khan Shinwari**
    Professor
    Quaid-i-Azam University
    Islamabad

15. **Engr. Abdul Mannan Usmani**
    Deputy General Manager
    Shan Foods
    Karachi

16. **Dr. M. Afzal Ghauri**
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17. **Dr. Tariq Majid**
    Manager Business Development
    Cirin Pharmaceuticals (Private) Limited
    Rawalpindi

18. **Dr. Khalid J. Chowdhry**
    Chairman & Chief Executive
    MediPak Group of Companies
    Lahore

19. **Dr. Musarrat Jabeen**
    Associate Professor
    International Relations
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20. **Dr. Khalid Khan**
    Director
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    Peshawar

21. **Mr. Ali Kamal**
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    Abt Associates
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22. **Dr. Arshad Ali**
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23. **Dr. Mohammad Ahsen Mirza**
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    Islamabad

24. **Mr. Iqtidar Zaidi**
    President & CEO
    Tech Access
    Islamabad

25. **Dr. Nazir A. Sangi**
    Dean Faculty of Science
    Department of Computer Science
    Allama Iqbal Open University
    Islamabad

26. **Dr. Shahida Saleem**
    Chairperson
    Standing Committee on IT &T
    Federation of Pakistan Chambers of Commerce and Industry
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27. **Dr. Khawar Siddiqui Khokhar**
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**Annexure - B**

# LIST OF PARTICIPANTS

1. Engr. Abdul Mannan Usmani, Shan Foods, Karachi
2. Dr. Abdus Sattar NIFA, Tarnab, Peshawar
3. Dr. Ahmed Sohail, College of E&ME, NUST, Islamabad
4. Mr. Ali Kamal, Abt Associates, Islamabad
5. Dr. Arshad Ali, NUST, Rawalpindi
6. Ms. Fareesa Malik, PSEB, Islamabad
7. Ms. Faroha Liaquat, Quaid-i-Azam University, Islamabad
8. Ms. Iffat Ashraf, GC University, Faisalabad
9. Dr. Iftikhar Ahmad Raja, CIIT, Abbottabad
10. Mr. Inamul Haq, TelecomPlus, Islamabad
11. Mr. Iqtidar Zaidi, Tech Access, Islamabad
12. Mr. Irfan Yousuf, AEDB, Islamabad
13. Dr. Khalid Farooq Akbar, GC University, Faisalabad
14. Dr. Khalid J. Chowdhry, MediPak Group of Companies, Lahore
15. Dr. Khalid Khan, D.o.S.T., Govt. of N.W.F.P, Peshawar
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19. Dr. M. Ahsen Mirza, CIIT, Islamabad
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21. Mr. M. Asim Ibrahim, PIEAS, Islamabad
22. Dr. M. Azam Khan, Permanent Raised Bed Project, Islamabad
23. Mr. M. Haneef, NARC, Islamabad
24. Mr. M. Khalil Khetran, AEDB, Quetta
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26. Dr. M. Maroof Shah, CIIT, Abbottabad
27. Mr. M. Tayyeb Javed, PIEAS, Islamabad
28. Dr. Mohsin Jamil Butt, CIIT, Islamabad
29. Dr. Musarrat Jabeen, University of Balochistan, Quetta
30. Dr. Nazir A. Sangi, Allama Iqbal Open University, Islamabad
31. Mr. Omer Farooq, Horizon Tech, Islamabad
32. AVM (R) S. J. Raza, Dawood Power (Pvt) Ltd., Karachi
33. Mr. Safdar Ali, M/o Petroleum and Natural Resources, Islamabad
34. Mr. Shahid Ahmad, NARC, Islamabad
35. Dr. Shahida Saleem, FPCCI, Karachi
36. Dr. Syed Tahir Hijazi, CIIT, Islamabad
37. Dr. Tariq Majid, Cirin Pharmaceuticals Pvt. Limited, Rawalpindi
38. Prof. Waqar Haider Bokhari, CIIT, Islamabad
39. Mr. Waqas Khalid, Dept of Mech. Engg., CIIT, Wah
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**Annexure - C**

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- Alternative Energy Development Board (AEDB), Quetta
- Cirin Pharmaceuticals (Private) Limited, Rawalpindi
- COMSATS Institute of Information Technology, Abbottabad
- COMSATS Institute of Information Technology, Islamabad
- COMSATS Institute of Information Technology, Wah
- Dawood Power (Pvt) Ltd, Karachi
- Directorate of S&T (D.o.S.T.), Peshawar
- Economic Affairs Division, Government of Pakistan, Islamabad
- Federation Pakistan Chambers of Commerce and Industry, Karachi
- GC University, Faisalabad
- Horizon Tech, Islamabad
- MediPak Group of Companies, Lahore
- Mehran University of Engineering & Technology, Jamshoro
- M/o Petroleum and Natural Resources, Islamabad
- National Agriculture Research Centre (NARC), Islamabad
- National Institute for Biotechnology and Genetic Engineering (NIBGE), Faisalabad
- National University of Science & Technology (NUST), Rawalpindi
- Nuclear Institute for Food and Agriculture (NIFA), Peshawar
- Pakistan Agriculture Research Council (PARC), Islamabad
- Pakistan Institute of Engineering and Applied Sciences (PIEAS), Islamabad
- Pakistan Software Export Bureau (PSEB), Islamabad
- Pakistan Telecommunication Authority (PTA), Islamabad
- Quaid-i-Azam University, Islamabad
- Shan Foods, Karachi
- Shakarganj Mills Ltd, Jhang
- Tech Access, Islamabad
- TelecomPlus, Islamabad
- University of Malakand, Lower Dir