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Energy Foresight Pakistan: Lessons from Energy Expert Panel meetings

Badar Sultan Minhas
Pakistan Technology Board
Pakistan

Abstract

An energy foresight under the Technology Foresight project was carried out to discuss viable technologies for the sustainable development of the energy sector in Pakistan, keeping in view the time horizon of 10-15 years i.e. 2020-2025. STEEP-V approach was used for collection of opinions, policies and projects for future energy needs. More than 20 experts participated in the STEEP-V brainstorming sessions having affiliations with R & D organizations, Ministry of Water and Power, researchers and professors in universities, NGO and private sector organizations. STEEPV which is an acronym for (Social, Technological, Environmental, Economic, Political and Values) is an internationally recognized tool for brainstorming used in conducting Technology Foresight worldwide. Most of the experts focused on indigenous solutions for meeting future energy requirements rather than importing the technologies. The main focus was on the promotion of renewable energy and energy efficiency/conservation. Greater emphasis in this regard was on energy education and ensuring support and incentives for research and development in the energy sector.

Keywords: Future, Energy Projects, Policies, STEEP-V, Energy Education, Awareness. Abbreviations: Technology Foresight (TF), Pakistan Technology Board (PTB), United Nations Industrial Development Organization (UNIDO).

Introduction and Literature Review

The Pakistan Technology Board was established to serve the nation regarding issues of technology. Energy technologies and problems related to energy have been the focal point of the whole nation for the past ten years and energy supply is considered as a core mission (Kolarz et. al., 2008) for the government of Pakistan. Indeed according to (Mojica, 2010), energy is regarded as the top priority for the development of any nation Even after 10 years of policy and planning, the crisis of energy is not over in Pakistan. Pakistan Technology Board, knowing that energy crisis will again rise in coming years, started the Technology Foresight project to provide continuous feedback

regarding the new technologies and relevant policies in the fast changing scenario of the whole world. At the same time it is expected to work as a facilitator for enhancing production (Mojica, 2010) in Pakistan. For that reason, based on a study by Siddiq (Forthcoming), energy was also highlighted by all the experts as one of the priority areas in which Technology Foresight should be conducted.

Energy is considered a basic necessity for humanity and the backbone of the economy of developed countries and to some extent it contributes in the economy of developing countries. Energy is considered as one of the key drivers influencing the future outcomes of a society (Gould, 2008). The world energy scenario during the past 2-3 years has been very eventful: oil prices fluctuated widely, leaving all vulnerable oil importing countries like Pakistan under great stress. This energy scenario eroded the purchasing power of the poor. Pakistan witnessed a slowdown in all the economic activities as a result of the international financial crisis. Now it needs huge amounts of energy supplies for its economic growth to enhance the standards of living of the people. (Annual Plan, 2008-09).

The energy consumption mix of Pakistan has changed over the past decade or so. The shares of gas and coal have increased to 40.3 percent and 13.3 percent respectively (Source: Hydrocarbon Development Institute of Pakistan).

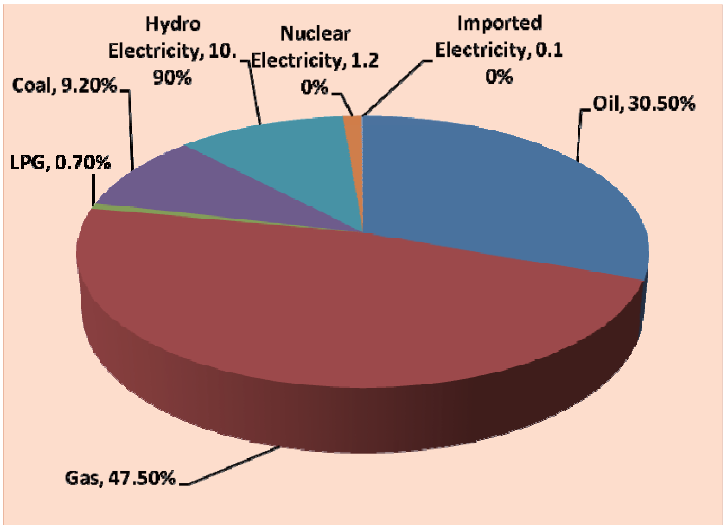

Figure 1. Primary Energy Supply by Source 2007-2008

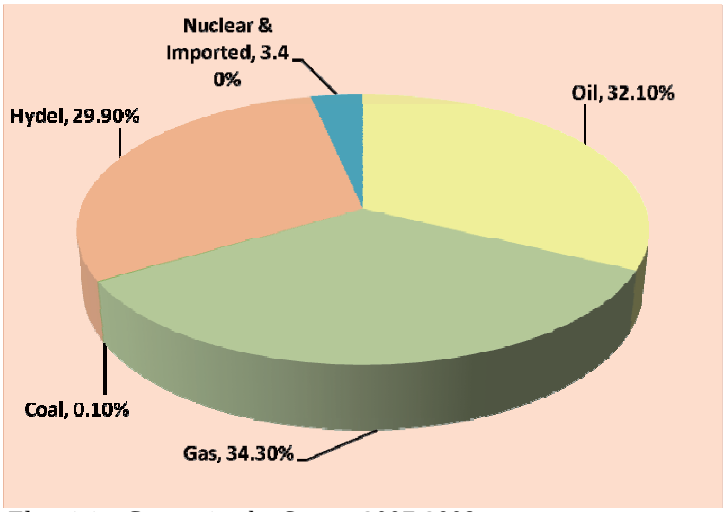

Figure 2. Electricity Generation by Source 2007-2008

Source: Hydrocarbon development institute of pPakistan

Pakistan has huge coal reserves but still the share of coal in Pakistan's electricity generation is low. (*Annual Plan 2008-09*). Extensive work is underway to use Thar coal-fired power plants coupled with carbon capture and sequestration to reduce CHG emissions.

Like coal, Pakistan also has a huge opportunity to exploit wind energy through a huge corridor which has a potential to generate 40,000 MW of energy. (AEDB policy, 2006)

According to an estimate Pakistan has following reserves of various sources of Energy.

Oil	326 million barrels proved reserves	(Pakistan Year Book 2008)
Natural Gas	26 trillion cubic feet proved reserves	(Pakistan Year Book 2008)
Coal	185 billion tons	(Pakistan Year Book 2008)
Hydroelectricity	46,000 MW identified potential	
Uranium	236 tons used for nuclear power generation since 1980	
Wind Energy	50,000 MW of economically exploitable wind power potential	
Solar Energy	Very good potential as the insolation rate amounts to 5.3 KWh/m^2	

To meet the growing demand of energy and the target of 9700 MW generation by the year 2030, the Alternative Energy Development Board (AEDB) has taken various initiatives. Under the remote village electrification program; AEDB is to electrify 7874 remote off-grid villages in the Sindh and Balochistan provinces through renewable energy RE technologies. (Economic Survey of Pakistan)

Portugal tried to reduce the consumption of energy by using innovative technologies and conducting R & D. (Conceicao et. al., 2004).

Renewable energy is expensive when it comes to establishing mega projects. Still experts believe that its success depends on government policies favoring its development in the long run. Turkey's Technology Foresight 2030 project focused on renewable energy and predicted the needs of energy satisfied by it will be almost 50 percent (Celiktas & Kocar, 2010). Government policies are recommended to be formulated in consultation with scientists (*IEE-IERE, 1973*) deeply involved in R & D and future planning so that future technologies can be proved successful in the long run.

Coal rich Pakistan, with depleting gas and oil reserves, needs long term planning to cope with the growing needs of energy in the country which is strongly linked with sustainable development. It also needs energy conservation planning and energy education and training programs (Beg & Armstrong, 1989).

There is an urgent need too for quicker conversion of energy systems from conventional to renewables that are sustainable and can meet the present and projected world energy demand. In the scenario of Pakistan solar and wind power are two of the most promising and most potential renewables. It has been found that solar energy is a much more economical choice for Pakistan as compared to wind energy because solar energy has fairly stable and consistent availability whereas wind energy due to being site specific and weather specific may not be as viable an option as solar. (*Economic survey, 2008-09*)

The following R & D organizations are working in the energy and power sector of Pakistan

- Ministry of Water and Power,
- Private Power and Infrastructure Board (PPIB)
- National Electric Power Regulatory Authority (NEPRA)
- Water and Power Development Authority (WAPDA)
- Karachi Electric Supply Corporation (KESC)
- Private Power Cell N.W.F.P.
- Private Power Cell Azad Jammu and Kashmir
- Private Power Cell Punjab
- Board of Investment (BOI)
- Privatization Commission
- Pakistan Atomic Energy Commission (PAEC)
- National Transmission Distribution Company (NTDC)
- Islamabad Electric Supply Company (IESCO)
- Lahore Electric Supply Company (LESCO)
- Faisalabad Electric Supply Company (FESCO)
- Multan Electric Supply Company (MESCO)
- Peshawar Electric Supply Company (PESCO)
- Hyderabad Electric Supply Company (HESCO)
- Quetta Electric Supply Company (QESCO)
- Gujranwala Electric Supply Company (GESCO)
- Alternative Energy Development Board(AEDB)

Methodology

Brainstorming (STEEPV)

A panel representing stakeholders from academia, industry, R & D organizations private sector and civil organizations (*UNIDO Manual, 2006*) met for about eight times during a period of about 15 months. The members were identified through face to face meetings and co-nomination process. The number of experts participating in all the eight meetings were about 22 however eight to nine members were regular and others participated in five to six meetings due to other commitments of their own. However, minutes of meetings were communicated to all through online groups and they were up dated about any new development in the meeting they missed.

The panel assessed the current situation and identified key opportunities for Pakistan in the existing scenario. The standard method of STEEPV, which is an acronym for Social, Technological, Economical, Environmental, Political and Values (*UNIDO Manual, 2006*) was used by panel members for the brainstorming sessions to identify a number of issues and drivers, policy recommendations, future viable projects and key areas of technological intervention. An important aspect of the methodology involved constructing the scenarios which could develop by 2020-2025. The scenarios were built on the uncertain drivers that could affect driving forces mentioned by the panel.

Table 1.
STEEPV: Identification of Issues and Drivers

Social	Technology	Environment	Economical	Political	Values
1. Public need oriented Technology Management 2.Awareness Campaign on use of energy efficient technologies ii. Energy conservation iii. Energy efficiency 3. Energy efficiency governance i. Enabling Frame works ii.Institutional agreements iii. Co-ordination Mechanism 4. Energy audit i. smaller household size ii. Cultural studies of wastage and usage of energy 5. Primary Education i. on importance of energy in daily life ii. Role of energy in socio-economic	1. Adoption of Indigenous technology 2.Battery manufacturing plant 3. LED technology, LFD technology, HFED technology 4. Energy presentation using low technology 5. Coal technology 6. Nuclear energy 7. Real Time data base 8. Pakistan resource data base 9. Alternative Energy/ Renewable Energy (Wind, Solar, Micro Hydel, Biomass, Waste to energy) 10. Energy efficient building 11. New electricity power storage system 12. Information and communication technologies i. New technologies	1- Low carbon energy system 2. Growing share of renewable energy 3. Education related to Energy Technology 2- REEE think tanks 3-Industry-Academia linkages 4-National thinking lacking 5-Natural resource management 6-Marketing oriented R & D environment 7-Carbon credits 8-Previous projects/project management 9.Enronmental benefits include many elements, such as reduced local pollution through burning less fuel, lower greenhouse gas	1-UNDP funding to wind energy technology 2- Un-economical high-tech purchase for educational institutes 3- incentives for research and technology 4- Dependence on foreign models is not economical 5- Patents and Royalties/ IPO. 5- Micro and Macro finance Institutes 6- Re-invention 7- Economic indigenous projects 8-Employment generation oriented project. 9- Zero- energy building 10. Introduction of incentives 11. Save energy bills	1-Banker's leadership 2-Scholars's political leadership 3-Abide by rules and regulations. 4-Awareness of decision makers. 5-Vested interests, monopoly/lobbies. 6-Technology policy. 7-Legislation policy. 8-PEMRA enforced media. 9. Implementation of energy policy	1-Religion oriented technology. 2-Simple life style. 3-Researchers low social value. 4-Feel human loss. 5-Ethics/ morals. 6-Journalist energy group. 7-Institutional- up gradation / evaluation.

development 6. Energy Education System i. in all sectors of the industry specially in those industry which share great percentage of energy consumption i.e. transport, steel, , cement, textile, etc	envisaged could improve efficiency in transport, energy, waste collection and other areas 13.Biomass integrated-gasification combined cycle and co-combustion 14. Coal: integrated-gasification combined-cycle 15.Coal: ultra-supercritical 16. Second generation biofuel 17. reduces the electricity consumption (kWh) and demand (KW) of air conditioning and refrigeration compressors	emissions, less use of firewood and hence less destruction Of forests. 10 climate change impact 11.environmental disaster			

STEEPV voting – importance

In this step each participant was allocated six post-it notes and the task was to use these as votes to nominate the drivers/issues which were believed to be most important in shaping the pattern of the development of the topic. Participants voted by sticking the post-it notes next to those drivers which were considered most important. The members were given choice to give all their votes to one issue/driver or distribute it among various drivers. The votes were recorded for further analysis and for presentation in the report.

Result of voting of drivers based on importance

Issues/ Drivers	No. of Votes
1. Energy efficiency	12
2. Renewable energy	07
3. Adaptation of Indigenous Technology	06
4. Support and incentive for research.	05
5. **Awareness campaign/ PEMRA enforced media coverage**.	03
6. Energy education system.	03
7. Natural resources management.	03
8. Financial support and commercialization of indigenous technology.	03
9. **Awareness of decision makers and politicians**.	03
10. Regulation and lobbying against vested interest.	03
11. Legislation and policy formulation.	03
12. Industry academia linkage.	02
13. Nationalism approach/ patriotism.	02
14. Journalist energy group.	02
15. Think tank.	01
16. Support for training and capacity building.	01
17. Economic indigenization of projects.	01

Merging of 5th & 9th issue/ driver

A consensus was achieved between the panel members to merge the driver no.5 and driver no.9 into one mega driver as both reflect more or less the same issue.

Awareness campaign/ PEMRA enforced media coverage. 06

Selection of top six issues/ drivers.

The task now was to write the top five or six drivers on the board and choose the drivers which had the most votes. The top five drivers were selected as there was clear concentration of votes but a tie was observed between drivers 6 and 11. At this stage a second round of voting took place and the "**Energy Education System**" was selected as the sixth most important issue/driver.

Result showing top six issues/ Drivers based on importance

1. Energy efficiency 12
2. Renewable energy 07
3. Adaptation of Indigenous Technology 06
4. Awareness campaign/ PEMRA enforced media coverage. 06
5. Support and incentive for research. 05
6. Energy education system. 03

STEEPV voting based on uncertainty

The task now was to vote on the issues and drivers considered to be most uncertain. The term Uncertain here refers to the level of Uncertainty in development of each driver and/or its impact on the topic under consideration. Each panel member was allocated 10 post-it notes and choice was given to use as many as he feels necessary. The key for Voting on Uncertainty was that If a member was very confident about the development of each driver he was asked to stick no post-it notes, if slightly uncertain, one post-it notes, if moderately uncertain, two post-it notes, and if highly uncertain then three post-it notes.

Result showing voting of issues/drivers based on Uncertainty

1. **Support and incentive for research**. 21

The experts focused on the point that the government should provide support and incentive for research and only through this our scientists and researchers will be able to conduct research keeping themselves updated with the latest trends.

2. **Energy education system**. 20

It is imperative that a well established energy education system exists in the country which educates the masses on how to use energy efficiently and how to make the best use of our resources.

3. **Renewable energy** 16

The experts believed that with the ever depleting oil and gas reserves, the focus should be on exploiting renewable sources like, solar, wind, biomass, biofuels and one of the emerging technology identified was that of **zero-energy buildings**.

4. **Awareness campaign/ PEMRA enforced media coverage**. 15

Pakistan Electronic Media Regulatory Authority should be forced to allocate 10 percent of their time for public service messages, including awareness on how to use energy efficiently and how to conserve the energy resources.

5. **Adaptation of Indigenous Technology** 14

The expert group highlighted the importance of developing technologies based on indigenous expertise and resources. This will be one way forward to lessen our imports and as a result save huge revenue.

6. **Energy efficiency** 13

The first step to solve the energy crisis is perhaps to use the already available energy resources more efficiently. The need is to promote energy efficient industries, domestic appliances, tube wells and to control energy theft.

Selection of top two uncertain issues/ drivers.

1. **Support and incentive for research**. 21

This driver gathered the most votes in terms of being most important but at the same time most uncertain, which means that the experts were not very confident of its development, and how it will affect the topic under consideration.

2. **Energy education system**. 20

The second most important and uncertain driver identified through voting was energy education system. The group was not confident of the development of this driver and what impact it will have on the topic under consideration.

These top two drivers were selected for development of scenarios first.

Development of Scenarios

Following tentative scenarios were built which required further deliberation from the participants.

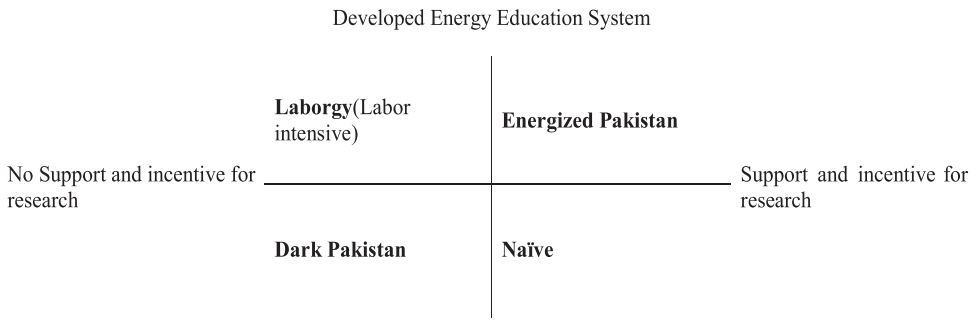

Figure 3. Inadequately Developed Energy Education System

Description of scenarios

Through following a STEEPV process, four alternative scenarios were developed on our energy sector. These scenarios give an insight to four various possibilities that can occur by 2020-2025 based on the findings of expert panel members of energy sector.

The members were asked to explore each of the four possible scenarios. Following a common practice in these exercises, participants were invited to imagine and think how each scenario would be at the horizon year, 2020-2025.

Scenario 1: (Laborgy Pakistan)

While fleshing out the Scenario One, the expert group on energy elaborated that if we consider that after 10-15 years i.e. by 2020-2025 we are in a position where we have developed an energy education system, where we teach and create awareness on energy related issues at all levels, but on the other side we are not able to provide any support and incentive for research, we will find ourselves in a position where we will

have a very laborgy Pakistan. (Labor intensive Pakistan). Currently in Pakistan's scenario, we observe that we do have a Research & Development system for researchers and scientists which is developed to some extent but we lack the incentives for them so that they can conduct research according to the latest trends and keep up with the developed world. The one reason for the energy crisis in Pakistan has been the lack of funds for our researchers and lack of any incentives to motivate them towards carrying out this all important research for sustainable development of our energy system.

Scenario 2: (Energized Pakistan)

While fleshing out Scenario Two, which is the ideal scenario, two situations were considered one whereby our researchers and scientists are provided with full incentives and research facilities and also where we have a very developed energy education system in Pakistan where the students at all levels are being taught about energy conservation. They would learn how to make energy efficient appliances and awareness of energy efficiency and conservation would be provided through seminars, workshops and courses. The experts labeled this ideal scenario as Energized Pakistan. To achieve the ideal scenario by 2020-2025, a number of steps will need to be taken on a time line of 10-15 years. A number of projects will have to be initiated, out of which certain projects will need to be initiated on a short term basis, others will be for mid-term while still more will be for long term development. The expert members devised a roadmap through which the ideal scenario can be achieved.

Scenario 3: (Naïve)

Discussing Scenario Three, the expert group imagined a future where we will have support and incentives for doing research on energy but on the other hand the system will not be supported by an adequate energy education system. This system although it will create opportunities for researchers and provide them incentives will not be backed up by creating awareness amongst the general population. It is a recognized fact that no country can progress if its education system doesn't support its research and awareness at grass roots level is not created. Today one major reason for our energy crisis is the lack of awareness amongst the general population on how to conserve energy and how to promote energy efficient methods. Resources are wasted through inefficient usage of energy. We need to create awareness amongst the decision makers and policy makers that the oil and gas resources are depleting very quickly and we need to rely on alternative/renewable sources of energy and on coal to meet our energy demands.

Scenario 4: (Dark Pakistan)

The last scenario, which is the least desirable scenario, was also discussed by the expert panel on energy. In this scenario we find ourselves in a position where we have no support and incentives for research and on the other hand our energy education system is inadequately developed. So through this we are neither supporting new R & D on energy and similarly nor are we creating any awareness on energy related issues. This scenario was labelled as Dark Pakistan. In order to avoid this scenario and achieve the ideal scenario a number of recommendations, future viable projects and

policy statements were given by the panel members. The need of the hour is to build on those recommendations and start taking the steps immediately.

Projects identified by the Energy Panel for sustainable development of the energy sector

During the eight panel meetings the members came up with a number of projects which must be initiated in order to move towards sustainable development of the energy sector. These projects are given below.

- Development of Domestic Solar Thermal Power Generation Unit
- Design and development of energy efficient houses for display to encourage investors
- Awareness raising campaign regarding usage of renewable energy and energy efficient technologies
- Replacement of traditional appliances (geysers, heaters etc) in government offices with renewable energy products
- Development of prototype electric vehicle powered by solar energy to replace Auto Rickshaw
- Development of biogas technology for domestic fuel needs of rural areas and production of bio-fertilizer. (Bio fuel gas generator)
- and development of zero energy building (Platinum building)
- Pilot projects on renewable energy products and their commercialization
- Installation of LED/LVD street lights in Islamabad
- Capacity building of professionals and of Building Control Authority regarding efficient usage of energy
- Establishment of coal briquetting manufacturing plant and coal sulphur cleansing/washing plant.
- Plantation of Jatropha plants and indigenous manufacturing of bio fuel conversion plant.

Conclusion and Recommendations

Pakistan's energy resources will determine its future development. Their protection and development, in turn, will depend on a robust education system, with R & D recognized as a priority (Kolarz et al, 2008). It will also benefit from training about renewable energy sources so future generations can develop such technologies, as the UN has done in China, Egypt, India, Thailand, Mexico and Brazil (*Khaparde, 2007*). Energy efficient technologies need to be promoted and the energy conservation strategy will need to be devised.

The overall research methodology was very productive and identified the issues and drivers very strongly. The development of scenarios depicted the various situations in which Pakistan can be on the horizon of 10-15 years. The solutions provided are based on very practical experience of all the experts and backed by reasoning through keeping an eye on the future. However, one recommendation for the future would be to add more political will and support in such exercises, so as to ensure the ownership at the top level and maximize the chances of implementing the outcomes.

All the experts believed that country like Pakistan needs to carry out foresight exercises on regular basis and make it a permanent activity for strategic planning and policy making. Indirectly highlighted by energy expert panel was Perfect Foresight for constantly analyzing the transitions, so that variance between the short and mid term demands with long term implications of the decisions made (*Keppo & Strubegger, 2010*) can be driven towards consistency. Other approaches such as Delphi survey could also be used as an additional approach to ensure wider consultation of experts.

Correspondence

Badar Sultan Minhas
Research Officer, PTB-Ministry of S&T,
H. 210, St. 1, F-10/3,
Tel: 0092-333-5216220
E-mail: badar.minhas@gmail.com

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