STRATEGIC ENVIRONMENTAL ASSESSMENT OF NATIONAL POWER POLICY 2013 AND NATIONAL POWER SYSTEM EXPANSION PLAN 2011-2030

2015

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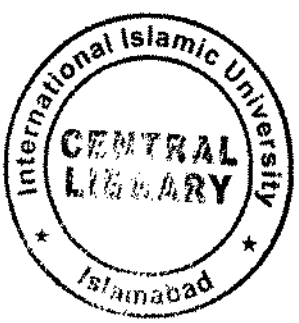

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- Environmental Risk Assesment
- Environmentalism -- Decision Making
- Environmental Impact Analysis

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A thesis submitted in partial fulfillment of the requirements for the award of degree of Master Studies of International Islamic University, Islamabad in

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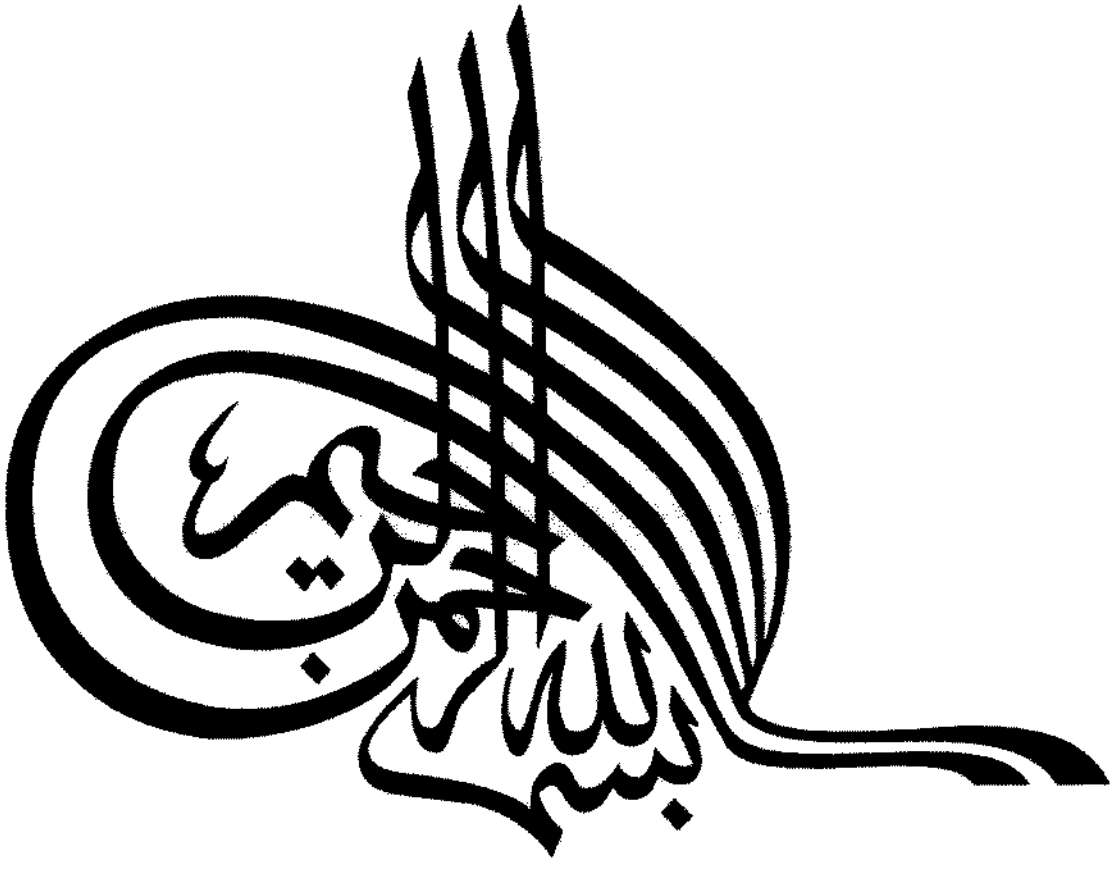
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Date: 31-08-2015

DECLARATION

I hereby declare that the work presented in this Thesis is my own effort, except where otherwise acknowledged and that the thesis is my own composition. No part of this thesis has been previously presented for any other degree.

Hazrat Bilal

Dated: 31-08-2015

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Hazrat Bilal

IN THE NAME OF ALLAH, THE MOST MERCIFUL AND BENEFICIENT

DEDICATION

This research work is dedicated to

my beloved mother

LIST OF ABBREVIATIONS

Acronyms	Abbreviation
ADB	Asian Development Bank
CCGT	Combined Cycle Gas Turbines
CNG	Compressed Natural Gas
EE	Environmental Evaluation
EIA	Environmental Impact Assessment
EP	Energy Policy
EU	European Union
GDP	Gross Domestic Product
GHG	Greenhouse Gases
GoP	Government of Pakistan
IPP	Independent Power Producer
IUCN	International Union for Conservation of Nature & Natural Resources
kWh	Kilo Watt Hour
MDG	Millennium Development Goals
MTDF	Medium Term Development Framework
MW	Mega Watt
NAP	National Agricultural Policy (2009-10)
NPP	National Power Policy 2013
NPSEP	National Power System Expansion Plan 2011-2030
NDP	Net Domestic Product
NEP	National Environment Policy
NIAP	National Impact Assessment Program
NMTPF	National Medium Term Priority Framework
NSDS	National Sustainable Development Strategy
OECD	Organization for Economic Cooperation & Development
PEPA	Pakistan Environmental Protection Act
PP	Policy and Plan
PPP	Policy, Plan, Program
RE	Renewable Energy
SEA	Strategic Environmental Assessment
SEAO	Strategic Environmental Assessment Objective
UNDP	United Nations Development Program
UNECE	United Nations Economic Commission for Europe
UNFCCC	United Nation Framework Convention on Climate Change
WAPDA	Water and Power Development Authority
WB	World Bank

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ABSTRACT

Strategic Environmental Assessment (SEA) is an important tool for incorporating environmental consideration into strategic decision making process. Globally energy related plans, programs and policies have experienced strategic environmental assessment. The present study aimed at reviewing related national policies, plans, and programs for pinpointing gaps and insufficiencies in the context of environment and sustainability. A modified methodology was applied following the general SEA process. SEA objectives and indicators were developed by looking at the baseline conditions and national environmental objectives. SEA objectives were compared against the national environmental objectives, related national policies, plans and programs.

This study has identified some sustainability windows in the power sector of Pakistan. The National Power Policy 2013 is not serious about the environment and Energy security. It was concluded that the national policies, plans and programs are made in isolation. National power policy has no commitment to reduce air emissions and to have a target for utilize of the huge renewable resources of the country. The projected power generation mix has negative impacts on the environment and as well as on the national energy security. The use of coal is a good option of the present but the continuous use will make the power sector more susceptible to climate change. There are inconsistencies between the national environmental objectives and SEA objectives. On the other hand there is lack of coordination between the national policies, plans and programs. The government must have a clear target for the utilization of renewable resources (excluding hydel) at least 30 percent by 2030. Through the present study it was revealed that SEA has a great potential for bringing sustainability in power sector of Pakistan. The government has to incorporate sustainability in the power sector by conducting SEA studies across the system.

Chapter 1

INTRODUCTION

1.1 Introduction

Energy is the backbone of economic development. The increase demand for energy has created concerns regarding the energy security and expanded the emphasis on productive allotment. It is projected that oil and gas will be the two main energy sources through 2040, representing around 60 percent of worldwide interest. Gas sector will develop at 1.6 percent annually from 2010 to 2040 being significant fuel source (The Outlook for Energy, 2010).

1.2 Pakistan's Power Sector

Pakistan's power sector is composed of WAPDA and Karachi Electricity Supply Company (KESC). The power sector has been rebuilt beginning with the making of Pakistan Electric Power Company (PEPCO) in 1998. Water and Power Development Authority (WAPDA) held responsibility for hydro plants while WAPDA's thermal plants have been dispersed to three Generation Companies (GENCOs). National Transmission and Dispatch Company (NTDC) is the main supplier of power and is in charge of the whole transmission system. There are ten Distribution Companies (DISCOs) which are responsible for forward conveyance to end purchasers. National Electricity and Power Regulation Authority (NEPRA) and Oil and Gas Regulatory Authority (OGRA) are the two national controllers.

On June, 2014 the installed capacity in the PEPCO system was 24,953 MW with hydro 7,097 MW, thermal 16,963 MW, nuclear 787 MW and wind 106 MW. Thus the hydropower capacity accounts for 28.4 percent, thermal 67.97 percent, nuclear 3.1 percent and a small portion of wind that is 0.24 percent.

Fiscal Year Ending 30th June	2010	2011	2012	2013	2014
Installed Capacity (MW)					
o WAPDA Hydro	6,444	6,516	6,516	6,733	6,902
o Thermal (Pub)	6,784	6,650	7,222	7,182	7,880
o IPP Hydro	111	111	111	195	195
o IPP (Thermal)	7,456	9,103	8,666	8,670	9,083
o Nuclear (PAEC)	462	787	787	787	787
o Wind	0	0	0	50	106
Total	***21,257***	***23,167***	***23,302***	***23,617***	***24,953***

Source: Power system statistics 2013-14 **Figure 1.1 Installed capacity 2014**

It is anticipated that 16,564 MW power generation will be added in the national grid system by 2018 through numerous resources by carrying out the new projects which will decrease the present shortage of power.

Year	Name of Project	Capacity	Agency	Fuel
2014	Guddu-1	(243 MW)	GENCOs	Gas
	Nandipur Power Project	(425 MW)	GENCOs	Oil
	Guddu-2	(243 MW)	GENCOs	Gas
	Quaid-e-Azam Solar Park (Phase-I)	(100 MW)	PPDB	Solar
	Quaid-e-Azam Solar Park (Phase-II)	(300 MW)	PPDB	Solar
	Guddu Steam (3)	(261 MW)	GENCOs	Gas
2015	Quaid-e-Azam Solar Park (Phase-III)	(600 MW)	PPDB	Solar
2016	Neelum Jhelum Hydel	(969 MW)	WAPDA	Hydel
	Golen Gol	(106 MW)	WAPDA	Hydel
	Patrind HPP	(147 MW)	PPDB	Hydel
2017	Terbela 4th Extension	(1410 MW)	WAPDA	Hydel
	Coal Plant at Sahiwal	(1200 MW)	PPDB	COAL
2018	Coal Plant at Jamshoro	(1320 MW)	GENCOs	COAL
	Thar Coal Plant	(1320 MW)	GENCOs	COAL
	Coal Plant Larkana	(1320 MW)	GENCOs	COAL
	Gaddani Power Park	(6600 MW)	Public + Pvt	COAL
Upto 2018 Total Generation Addition		**16564 MW**		

Source: Pakistan Electric Power Company (Pvt) Limited (PEPCO)

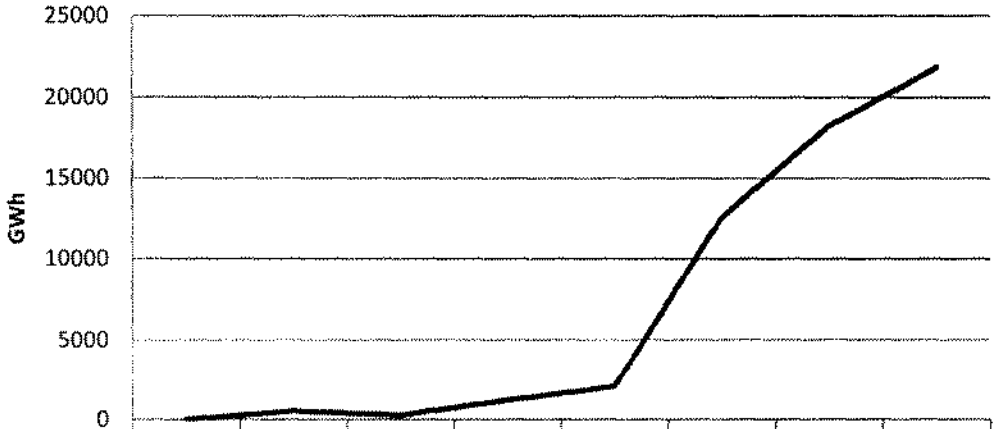
Figure 1.2 Future Projects

1.3 The Crisis

Energy blackouts hampered financial development of Pakistan in the last years. Since mid-2000s, the energy sector got more noteworthy consideration as a result of the quicker rate of development in its request. The administration put all endeavors to determine the issue still the load shedding is not over. As the shortage of electricity has influenced each one, along these lines determining energy emergency got quick need in pronouncements of all political gatherings which contended in the 2013 elections.

The power sector of has assailed by a large group of issues and weaknesses. Unfortunately, numerous positive activities have been actualized, an excess of chances have been lost and changes switched. The power generation authorities have not met the demand of the country. Deficiency of power and gas has genuinely started to hurt the individuals and harm the economy (Burki, 2008). According to the New York Times "Pakistan is in the throes of a energy emergency, with Pakistanis now continuing around 12 hours of force cuts a day, a tiring calendar that is dissolving ice, ceasing fans and maddening an effectively depleted people generally as the impact heater of summer begins". Between 2008 and 2009, electricity blackouts have increased by 30 percent. After the disastrous surges of 2010, there are zones where every day power blackouts surpass 18 hours. Further deficiency in the power sector will cause social change among the individuals who are most seriously influenced (Husnain, 2010).

Aziz, et al. (2010) demonstrated that how lack of electricity is affecting Pakistan's economic development. According to their estimates electricity shortages in the industrial sector was over $3.8 billion in 2009 and was about 2.5 percent of the gross domestic product (GDP). It was further said that half million jobs and exports worth $1.3 billion were vanished and this was only the tip of the iceberg.



	1	2	3	4	5	6	7	8
Year	2003	2004	2005	2006	2007	2008	2009	2010
GWh	0	520	265	1208	2040	12578	18222	21821

Adapted from NTDC, 2011 **Figure 1.3 Electricity shortfall**

1.4 Problem Statement

The energy sector plays an important role in national economies and its development, being fundamental to production and population well-being (Pererira *et al.,* 2008). However, there are significant environmental costs associated with energy supply and use that need to be considered. To assess the impacts related to energy infrastructure and activities, Environmental Impact Assessment (EIA) is usually applied at project level. Nonetheless, EIA have not got the confidence so far to handle the challenges related with energy supply. EIA is applied at geared to individual projects, while the issues we now countenance require being handling at an advanced level of planning. Environmental consideration needs to be incorporated into overall energy frameworks at a much earlier stage of conception. The necessity to assess the environmental consequences of higher decision making level is been pointed (Tolmaskim *et al.,* 2001), especially based on doubts about EIA ability to deal with energy supply challenges (Jay, 2010), being the Strategic Environmental Assessment (SEA) indicated as an important instrument to deal with these challenges earlier (Jay, 2010). In Pakistan, even though SEA is not mandatory to be carried out for plans, policies or programs but the National Environmental Policy of 2005 of Pakistan and the National Climate Change Policy of 2012 imitate the commitment for SEA. It is the requirement of sustainable development to integrate environmental considerations in the development of policies, plans and programs and

their implementation. Though, the current decision making system is not able to integrate economic and social aspects and to incorporate environmental consideration at the policy, planning and accomplishment levels. The last decades are witnessed for poor and isolated power policies plans and programs based on the political parties' interest. For a sustainable and rational power plan, policy and program it must be integrated with other related government policies and plans. The aim of this study is to strategically assess the environmental impacts of national power policy and national power expansion plan 2011-2030. To incorporate sustainability in power sector of Pakistan and to provide alternatives and mitigation measures to achieve the desired objectives.

1.5 Objectives of the Study

The goal of this study is to seek and pinpoint incompatibilities and inconsistencies in the national policies, plans and programs dealing with power sector.

- To propose measures to remove the identified distortions and inconsistencies in the existing policies and plans dealing with power sector in relation to environment.
- To assess the potential of using SEA as tool for the assessment of national power policy and national power expansion plan.
- To assess impacts of national power policy and national power expansion plan on Human health, Economy and Environment.

1.6 Significance of the study

After the strategic environmental assessment of the national power expansion plan and national power policy, it is expected that this study will provide input for incorporating sustainability to the power sector by giving sustainable and environment friendly alternatives. This study will identify measures and will recommend how to increase the positive impacts and minimize the negative impacts to achieve the desire objectives. A baseline for further research will also be built.

Chapter 2

LITERATURE REVIEW

2.1 Global Perspective

The earliest experience of SEA was in relation to land use plans; for example, UK planning authorities carried out a rudimentary form of SEA on their statutory development plans during the 1990s (Curran *et al.*, 1998). Some attention was also given to SEA within other public sectors, especially transport (Fischer, 2002). But from the beginning, the energy sector was also reckoned to be an ideal candidate for SEA. The central importance of energy to national economies, and the significant environmental issues associated with energy supply and use, gave weight to this argument (Therivel *et al.*, 1992). It was suggested that SEA should be applied both at a broad policy level and in the planning of new capacity, especially for renewable energy (Sheate, 1996).

Indeed, there are examples of energy SEAs during this period, both for overall energy policy and for individual components of the industry. One of the earliest of these was an SEA in 1992 of the Netherlands' national electricity supply plan, carried out by government departments. The plan provided policy direction for the country's fuel mix, and indicated locations for plant and transport facilities. The SEA involved the consideration of different energy scenarios and produced restrictive criteria for the siting of power stations (Sheate, 1996).

2.2 SEA in Energy Sector

Sectoral environmental assessment for the Nepal Hydropower Development Project was carried out by the Ministry of Water Resources in collaboration with the Ministry of Population and Environment. The Department of Electricity Development, the Nepal Electricity Authority, and the Alternative Energy Promotion Centre were involved in implementation. The objectives of the study were to identify the medium-scale hydropower projects with the greatest potential in the sector and provide an environmental impact assessment framework for future subprojects. The sectoral environmental assessment mounted a broad review of Nepal's hydropower potential, hydropower policy, the existing power system and its past and future load growth, and export potential. It explored alternative generation options, prospects for fossil fuels, renewable energy sources, and

demand-side management. The main approach was to incorporate environmental and social criteria into the selection of power supply options. The screening and ranking method used for the assessment gave a contribution in making the optimal choice of subprojects from the viewpoint of electricity supply while minimizing the environmental and social costs. The assessment process resulted in capacity building both in the Nepal Electricity Authority and in the government agencies that participated in the interagency consultative group. The assessment also contributed to greater transparency and broader stakeholder participation in decision making. Through broad stakeholder participation and a consensus-building approach, the assessment helped ensure broad public endorsement of projects and avoid costly delays. To a certain extent, it was assisted in project optimization and feasibility design, including environmental and social mitigation measures (Nepal, Ministry of Water Resources, 1997).

Strategic environmental assessment of the national Energy policy of Malta 2009 was conducted by private consultants for Malta resources authority. The main impacts on biodiversity including fauna and flora were from the implementation of new projects for the provision of infrastructure. The implementation of measures to reduce the use of fossil fuels for energy generation will have positive effects on human health. At a strategic level, the draft EP was considered to have positive impacts on air quality. The implementation of measures to reduce the use of fossil fuels for energy generation will likely reduce air emissions and greenhouse gas emissions. Impacts on cultural heritage were generally project specific. Minimization of hazardous waste will be achieved mainly from the decreased usage of heavy fuel oil. Although alternative technologies were contemplated in the draft EP for the reduction on reliance on fossil fuels, the continued use usage of heavy fuel oil in the short term will not achieve the objective of minimizing hazardous waste production. It was assessed that indirect positive impacts will result from reduced emissions from traffic and the power stations (SEA of National Energy Policy of Malta, 2010).

The Department of Energy and Climate Change (DECC) in England has conducted SEA for the Future Leasing for Offshore Wind Farms and Licensing for Offshore Oil & Gas and Gas Storage. It was assessed that marine mammals are at highest sensitivity to acoustic

noise disturbance generated by offshore wind farms, hydrocarbon exploration and production activities. Activities associated with offshore wind farm development, exploration and production of oil and gas, and gas storage can lead to physical disturbance of seabed habitats, with consequent effects on seabed features and biotopes and potentially on archaeological artifacts. In particular, scour a localized erosion and lowering of the seabed around a fixed structure was recognized at an early stage as a potential issue in relation to wind turbine foundations, and has been subject to considerable research and monitoring. The major development of offshore wind farms envisaged by the draft plan/ programme could result in significant effects on landscape/seascape.

It was further concluded that there were no overriding environmental considerations to prevent the achievement of the offshore oil and gas, gas storage and wind elements of the PP albeit with a number of mitigation measures to prevent, reduce and offset significant adverse impacts on the environment and other users of the sea (DECC, 2009).

The SEA for the Energy Policy of the Czech Republic was the first pilot SEA in the country. The SEA began after the Energy Policy had been drafted in 1998, and was conducted by an external consultant. Three basic policy alternatives were established. Indicators were then used to compare the three alternatives against each other. Following this preliminary assessment, a more detailed multi-criteria analysis was undertaken to reflect the social values attributed to each impact category (i.e. environmental, resource, social and economic impacts). The draft of SEA Report was provided to the Ministry of Industry shortly before the change of Government. The incoming Government decided to re-do the Energy Policy and decided to ignore the SEA results. A new Energy Policy was drafted and a new consultant employed to undertake the SEA. Neither the policy nor the SEA was prepared in a transparent manner, and completion of the nuclear power plant later became a matter of international dispute between the Czech Republic and Austria. The SEA for the new revised Energy Policy was considered to be poor quality and is was widely considered as an example of the most biased SEA in the country (Muller *et al.*, 2007).

Strategic environmental assessment of the Offshore Renewable Energy Development Plan of Ireland was conducted by Minister for Communications, Energy & Natural Resources, Ireland. The overall conclusion of the SEA found that it would be possible to achieve the

high scenario of 4,500 MW from offshore wind and 1,500 MW of wave and tidal devices without likely significant adverse effect on the environment. These development levels were not assessed from the perspectives of commercial or technical feasibility. The commercial and technical feasibility of individual projects were ultimately dependent on the route to market availability and the state of readiness of the various technologies. The findings of the SEA set out the levels to which such development could be carried out without significant adverse effect on the environment (Minister for Communications, Energy & Natural Resources, Ireland, 2014).

SEA study was undertaken as a part of the extensive environmental and social assessment for the Nam Theun II Hydropower Development, Lao Peoples Democratic Republic project development required by the World Bank. These examples of SEAs are unusual in that they were triggered by, and were part of, a project level EIA study rather than the other way around. The NT2 project was so far advanced and so dependent on resolution of immediate project-related environmental and social issues, that these more strategic studies were unlikely to be influential. Nevertheless, the CIA study provided reassurance that cumulative impacts were manageable and gave direction to future capacity building and institutional initiatives in handling them. The lack of detailed analysis and reliance on data in the SIA study limited its recommendations to generalities and consequently diminished its influence.

The studies also illustrate that, although stakeholder engagement is important, the relevant stakeholders for longer-term strategic studies such as these can be confined to governments and some strategic partners such as international funding organizations and some NGOs. Local groups potentially affected by decisions yet to be taken some years hence are unlikely to engage in these strategic studies.

Finally, the studies illustrate the importance of trust and good working relationships between the government and the development partners. This factor is seldom discussed or analysed but, without it, the complex and long-running environmental and social analyses, both tactical and strategic, would not have been initiated or completed to provide the strong basis on which the decision to proceed with the project was undertaken (Norplan, 2004).

SEA of the Quang Nam Hydropower Plan Vietnam was conducted under the revised Law on Environmental Protection (LEP). The methodology used was trend analysis. The study suggested that hydropower plans and strategies had been made without looking at the big picture, and as a result, these projects might have negative impacts on the environment. In addition, the Quang Nam Provincial People's Committee (PPC) pledged its full support for the issue of biodiversity conservation and the recommendation to maintain a number of intact rivers in order to develop nature tourism and promote economic growth in the long term (WWF, 2008).

SEA of Canadian energy policy was conducted by Noble, (2002). The methodology, based on a generic seven phase assessment frameworks, was explained and demonstrated through a case study assessment of alternative options for Canadian energy policy. Five energy policy scenarios were presented and assessed by an expert panel on the basis of several environmental and socio-economic assessment criteria using a paired comparison assessment process. Impact assessment data was aggregated and analyzed using a multi-criteria approach to identify the preferred strategic direction for energy policy development. SEA recommended renewable energies as the best strategic alternative.

SEA for a National Plan on the Production of Electricity was carried out by the Netherland government. The objective was to identify locations of power plants with a capacity over 500 MW. Choice of fuel type and maximum generating capacity for each of the fuel types. On the basis of the SEA 18 sites were accepted as suitable sites for electricity generation; for each site it was decided for which type of fuel it was suitable. As to fuel usage, it was decided that in 2010, only 33% of the electricity needed should be generated using coal, with a maximum of total 6000 MW. New power plants should use coal gasification (Ministry of the Environment Government of Japan, 2003).

Under the Slovak Republic's EIA Law, initially implemented in 1994, environmental assessments are required for development policies in a number of sectors, including energy. The SEA was carried out under the ministry of environment. The SEA process considered economic as well as environmental and social factors, yielded many modifications to the draft energy policy. For example, the government's draft was changed to encourage

diversification of energy sources and "de-monopolization" and decentralization of the energy sector (Ahmad *et al.*, 2008).

SEA of the Vietnam Power Development Plan VII recommended in reducing the heavy dependency on coal whose impacts amount to several billion dollars by 2030. A strategy that combines improved energy efficiency with accelerated renewable energy development – including identification of specific sites for RE investments would go far to reduce coal related dependency and impacts. Additional recommendations were made for hydropower plants, particularly focusing on improvements in the support and compensation measures PDP VII layout for people displaced by hydropower plants. The SEA also recommended to evaluate payment for environmental services (PES) mechanisms as a means to share the benefits of environmental services for hydropower performance with local communities and engage them actively in related forest and watershed protection (community forestry, biodiversity management plans). Two particularly high-impact schemes Dak Mi 1 and Dong Nai 5 were recommended to be cancelled due to their high environmental cost (John *et al.*, 2012).

The SEA report of Tidal Energy in Nova Scotia's Bay of Fundy recommended the resource remain under government ownership and management. The resource is developed in a way that ensures net reductions in greenhouse gas emissions. Federal and provincial governments should cooperate in the management of the resource. Decisions about commercial development should only be made incrementally and after technologies are proven to be environmentally sound. Effects on other users of the Bay of Fundy that cannot be mitigated must be fairly compensated. Net social and economic benefits over the long term should be ensured and maximized. Community development should be a priority. Decisions should be made in the context of an integrated management approach, and decisions should be made in a transparent manner (Doelle, 2008).

Chapter 3

METHODOLOGY

3.1 Methodology

There is no specific methodology for SEA. The procedure of SEA varies from sector to sector. SEA is a versatile method as opposed to a precise analytical methodology. As described by Nilsson, *et al.,* (2005) techniques must be chosen in every application to cover each of the diverse phases of the methodology. These may incorporate diverse sorts of futuristic studies (scenario exercises), systems analysis, risk assessments, life cycle assessments, economic appraisal tools, and multi criteria analysis. Below is the methodology used to predict and assess environmental effects within the SEA framework for the identification of alternatives for sustainable power sector in Pakistan. The segments of methodology were depicted from intensive review of literature. The methodology of this study was composed of three stages; each stage is firmly related with all the others.

The four phases of the procedure were:

1. External coherence analysis (ECA)
2. Internal coherence analysis (ICA)
3. Compatibility assessment of objectives
4. Analysis of alternatives (AA)

3.1.1 External coherence analysis (ECA)

Fundamental objective of SEA is to check whether the proposed PPPs are environmentally sustainable (Mc Cluskey and Joao, 2011), through the development of coherence analysis is to affirm if the PPPs general objectives are successfully fit with the environmental objectives. A double entry matrix was used for the assessment of this aspect, in which in the rows were listed the environmental goals of superordinate plans or programs, and in the columns the overall goals

of the PPPs were placed. In this way, elements of the PPPs that are not harmonized with their superordinate tools were determined (Table No. 3.1).

Table No. 3.1 Template for External coherence analysis (ECA)

PP goals / Environmental goals	1	2	3	4	5	6	7	n
1	0	1	2		0			
2								
n	1			2				

0 = no impact, 1 = insignificant impact, 2 = significant impact

3.1.2 Internal coherence analysis (ICA)

In this step the rationality between National Power Policy and National Power System Expansion Plan 2011-2030 objectives and the proposed activities were analyzed. All objectives of the National Power Policy and National Power System Expansion Plan 2011-2030 were placed in rows, and planned activities were recorded in the columns.

Table No. 3.2 Template for Internal coherence analysis (ECA)

SEA objectives	Objective 1	Objective 2	Objective n
PP Objective 1	√	√	
PP Objective 2	×		√
PP Objective 3	×		
PP Objective 4		√	

×=incompatible, √=compatible, blank= no links

3.1.3 Compatibility assessment of objectives

The compatibility of the SEA objectives with the National Power Policy and National Power System Expansion Plan 2011-2030 objectives was assessed by using the following matrix (Table No. 3.2). Objectives of the National Power Policy and National Power System Expansion Plan 2011-2030 were tested against the SEA objectives to identify

both potential synergies and inconsistencies. This information was also helpful in the development of alternatives.

3.1.4 Analysis of alternatives (AA)

The environmental indicators were carefully selected for the purpose of evaluating the potential impacts of the alternatives that are being considered for the national power policy and national power system expansion plan 2011-2030. With the assessment criteria typically arrayed as the columns of the matrix and the indicators as the rows (Table No. 3.3), the cells are comprised of numbers which provide a measure of the expected impacts of the indicators when measured against the assessment criteria (Pastakia and Jensen, 1998).

Table No. 3.3 Assessment of alternatives (AA)

	Option 1				**Option 2**		
SEA objectives	**Short term**	**Medium term**	**Long term**	**Comments/ explanation**	**Short term**	**Medium term**	**Long term**
	+/–	–	++/– –		?		o

+ = Positive, – = negative, 0 = neutral, ? = Uncertain, +/– = minor, ++/– – = major

3.2 Important Areas to Consider

Following were the important areas that were including in this study, that how these areas were important and relevant to the national power policy and national power system expansion plan 2011-2030.

Table No. 3.4 Important areas to consider

Areas	**Environmental Objectives**	**Justification**
Social	Population and Human Health	The power sector is likely to have significant (direct & indirect) positive and negative environmental consequences on human population and health.
	Cultural Heritage	There are numerous important natural and cultural heritages in the Pakistan. Power sector has high potential to affect some of these assets directly (Construction) or indirectly (Acid rain and floods).

	Environmental Justice	Natural Justice is the reasonable treatment and significant contribution of all individuals paying little heed to race, shading, national starting point, or pay regarding the advancement, usage, and authorization of environment laws, regulations and strategies (U.S EPA). Environmental justice would be an integral part of strategic option development and SEA process.
Environmental	Climate Change	Thermal power generation is one the driver for increasing greenhouse gas emissions in Pakistan. Effects of climate change will be integral part of the strategic options considered for power sector.
	Biodiversity, Flora and Fauna	Pakistan is rich in biodiversity, supporting various ecosystems e.g Mangrove Forest and wetlands; is flyover route for many migratory bird species and habitat for red listed endangered. Therefore, The power sector is likely to have negative and positive impacts on the biodiversity of natural ecosystems.
	Water	Pakistan has numerous water issues (e.g. low flow, sedimentation load, water scarcity) and construction of dams can affect the water resources and water quality (marine and fresh water).
	Air quality	Air quality is important factor to be considered in environmental assessment process dealing with the power generation options.
	Soil	The construction activities and the disposal of waste from the power generation have negative impacts on the soil properties. The transportation of fuel and waste has also the potential to harm the soil quality.
Economical	Economy	Consideration of economic factors is an integral part of all development planning and in this case it is one of the criteria for the assessment of impacts. Implementation of options has potential to impact both negatively and positively economic activities within the study area.
	Material assets	To meet the future energy demands both renewable and nonrenewable resources will be utilize.

Chapter 4

RESULTS AND DISCUSSION

4.1 Screening

According to the SEA directive environmental assessment shall be carried out for all plans and programs, which are prepared for agriculture, forestry, fisheries, energy, industry, transport, waste management, water management, telecommunications, tourism, town and country planning or land use and which set the framework for future development consent of projects listed in Annexes I and II to Directive 85/337/EEC. National Power Policy and National Power System Expansion 2011-2030 qualify to go through SEA.

4.2 SEA Objectives and Indicators

It is not the requirement of SEA Directive to develop SEA objectives, but SEA objectives are used to confirm that the right level of consideration is accomplished. The following SEA objectives are developed from the review of baseline information and environmental problems related with power sector. The SEA indicators are dimensions of trends. Variations in the indicators show whether the execution of the National Power Policy and National Power System Expansion 2011-2030 would be or has been successful in improving the environmental quality. However changes in the indicators could be the result of external factors outside the range of National Power Policy and National Power System Expansion 2011-2030.

Table No. 4.1 SEA objectives and indicators

Issues	SEA objectives	SEA indicators	Data sources
Air	• To reduce emissions in accordance with the NEQs and international agreements	• Emission values from the power sector • Consistency in air parameters with NEQs	EPA, SUPARCO
Soil	• To Avoid land contamination during the transportation and construction activities	• Land contamination at specific sites at project level; • Number of oil spill incidents	EPA
Material assets	• Promote generation of energy from renewable resources • Minimize production of hazardous waste • Create awareness regarding energy conservation and sustainable utilization	• Number of projects, funds and initiatives implemented that support renewable sources • Hazardous waste produced by energy infrastructure • Biofuel consumption (increase)	Alternative Energy Development Board, Ministry of Finance, Ministry of Petroleum & Natural Resources
Cultural heritage	• Preserve historic buildings, monuments, archaeological sites and other culturally important features	• Number of operations located away from cultural heritage sites / areas or areas with known cultural / archaeological remains • Status and number archaeological sites	Ministry of Information, Broadcasting and National Heritage, Heritage Foundation of Pakistan
Climate change	• Reduce greenhouse gases emissions from the power sector in compliance with the national	• Emissions of greenhouse gases from energy • Increase in the use of renewable energy resources	Ministry of Climate Change, EPA, Planning Commission of Pakistan,

	targets and international agreements		SUPARCO, Pakistan Meteorological Department
Water	• Reduce pollution to the marine and fresh water environment from power generation.	• Quality of the marine environment; • Quality of groundwater; • Number of water pollution accidents; • Status of water availability per capita, per sector and per dependent habitat	EPA, WARSA, PCRWR, IRSA
Population & Human health	• To reduce negative health impacts arising from air and water pollution • Protect vulnerable consumers • Create recreation facilities	• Emission values from the power sector • Number patients suffering from air and water related diseases in the vicinity of power generation activities • Rate of mortality • size of population and changes in demography • years of healthy life expectancy / infant mortality rate	Ministry of National Health Services Regulations and Coordination, Provincial Health Departments
Biodiversity, Flora & Fauna	• To avoid damages to biodiversity (including terrestrial and marine) in line with national objectives and international agreements	• Status, percentage and coverage of protected areas, • Status and number of species • Status of the forest cover	EPA,IUCN, WWF, Ministry of Environment
Economy	• To achieve national and international developmental goals in a sustainable way.	• Status of the life style • Status of the GDP and NDP	Ministry of Finance, Pakistan Bureau of Statistics

Environmental Justice	• To involve the affected community and general public at an early stage of planning	• Number of consultation studies and public involvement in the power sector PPPs	Planning Commission of Pakistan, EPA

4.3 Internal compatibility of the SEA objectives

The internal compatibility of the SEA objectives has been examined to identify potential regions of consistency and clash in connection to every goal. The ten objectives are in harmony with one another. For instance the objective to enhance water quality is steady with improving biodiversity and ensuring human health. Sometimes, there is no agreeable relationship between the objectives, e.g. no immediate connection between enhancing soil quality and impacting environmental change or cultural heritage.

Table No. 4.2 Internal compatibility of the SEA objectives

Air	√									
Soil	√	√								
Material assets	√	√	√							
Cultural heritage	√	0	√	√						
Climate change	√	0	√	0	√					
Water	√	√	√	0	0	√				
Population & Human health	√	√	√	0	√	√	√			
Biodiversity, Flora & Fauna	√	√	√	√	√	√	√	√		
Economy	√	√	√	0	√	√	√	√	√	
Environmental Justice	√	√	√	√	√	√	√	√	√	√
SEA Objectives	Air	Soil	Material assets	Cultural heritage	Climate change	Water	Population & Human health	Biodiversity, Flora & Fauna	Economy	Environmental Justice

4.4 Compatibility assessment of the National Power Policy 2013 and National Power System Expansion Plan 2011-2030 objectives with the national environmental objectives

The national environmental objectives were tested against the National Power Policy2013 and National Power System Expansion Plan 2011-2030 objectives to get a broader perspective of the coherence between the national PPPs. Most objectives of National Power Policy 2013 and National Power System Expansion Plan 2011-2030 are compatible with the national environmental objectives; however the main objective of the National Power System Expansion Plan 2011-2030 was conflicting with most of national environmental objectives. According to the National Power System Expansion Plan 2011-2030 the power demand will be 98,120 MW consisting of 35.7% of hydro power, 38.1% of steam turbines using Thar coal, 10.3% of CCGT, 6.7% of nuclear, 2% of interconnections, 7.2% from gas turbines and renewable energy sources. This energy mix was conflicting with most of the national environmental objectives (See table 4.3).

Table No. 4.3 Compatibility assessment of the National Power Policy, National Power System Expansion Plan 2011-2030 objectives with the national environmental objectives

S.no	National Power Policy and National Power System Expansion Plan 2011-2030 goals / Environmental goals	Build a power generation capacity that meets the needs in a sustainable manner	Create a culture of energy conservation and responsibility	Use of inexpensive indigenous resources such as coal (Thar coal) and hydel	Promote efficiency in power generation	Minimize financial losses across the system	Minimize pilferage and adulteration in fuel supply	Align the ministries involved in the energy sector and improve the governance	Minimize inefficiencies in the distribution system	To meet the expected load up to the year 2030 by utilizing the available resources	Create a cutting edge transmission network
1	Conservation, restoration and efficient use of natural resources	√	√	X	√	√	√	0	√	X	√
2	Environmental awareness	√	√	0	0	0	√	√	0	0	0
3	Effectively manage and conserve the country's water resources	√	√	X	√	0	√	√	0	X	0
4	Ensure Food security	0	0	0	0	0	0	0	0	0	0
5	Mitigation and adaptation to climate change	0	√	X	√	0	√	0	0	X	X/√
6	To pursue sustained economic growth and reduce poverty	√	√	√	√	√	√	√	√	√	√
7	To prevent, reduce and mitigate health impacts	0	√	X	0	0	√	0	0	X	X
8	To reduce , recycle and reuse of solid wastes	√	√	0	√	0	0	0	0	X	0
9	Restoration, maintenance,	√	√	√	√	√	√	0	√	X	0

	conservation and efficient utilization of natural forests										
10	Conservation, effective management of protected areas and sustainable use of biodiversity	√	√	√	√	√	√	0	√	X	0
11	Promote energy efficiency and renewable sources of energy	√	√	X	√	√	√	√	√	X	√
12	Protection and preservation of agricultural land	√	√	0	0	0	0	0	0	X	X
13	Increase the development of renewable energy technologies	√	√	√/X	√	0	0	0	√	X	X/√
14	Reduce air emission in accordance with the national environmental quality standards	√	√	√	√	0	√	0	√	X	X/√
15	Reduce greenhouse gases and promote ozone friendly technologies	√	√	√	√	√	√	0	√	X	X
16	To combat desertification and mitigate the effects of drought	√	√	√	√	0	√	0	√	X	X
17	To reduce involuntary resettlement	√	√	X	√	√	0	0	√	X	X/√
18	To decrease reliance on imported energy and promote the exploration of indigenous resources	√	√	√	√	√	0	0	√	X/√	√

Note: Compatible=√, Neutral=0, Conflicting=X

4.5 Compatibility of National Power Policy, National Power System Expansion Plan 2011-2030 objectives with relevant national PPPs objectives

According to the SEA directive the environmental report must provide information on the PPP relationship with other relevant plans and programs. According to the NPSEP 2011-2030 the power demand will be 98,120 MW consisting of 35.7% of hydro power, 38.1% of steam turbines using Thar coal, 10.3% of CCGT, 6.7% of nuclear, 2% of interconnections, 7.2% from gas turbines and renewable energy sources. The generation of almost 35000 MW from hydro will pose threats to the biodiversity by the construction of a huge number of dams. It is also incompatible with the national resettlement policy because the policy is committed to reduce the involuntary resettlement but the construction of dams will force people to migrate.

Table No. 4.4 Compatibility of National Power Policy, National Power System Expansion Plan 2011-2030 objectives with relevant national PPPs objectives

S. no	Relevant PPPs	Relevant PPPs Objectives	National Power Policy and National Power System Expansion Plan 2011-2030 Objectives									
			Build a power generation capacity that meets the needs in a sustainable manner	Create a culture of energy conservation and responsibility	Use of inexpensive indigenous resources such as coal (Thar coal) and hydel	Promote efficiency in power generation	Minimize financial losses across the system	Minimize pilferage and adulteration in fuel supply	Align the ministries involved in the energy sector and improve the governance	Minimize inefficiencies in the distribution system	To meet the expected load up to the year 2030 by utilizing the available resources	Create a cutting edge transmission network
1	National Climate Change Policy 2012	To integrate climate change in the vulnerable sectors of the economy to ensure climate resilient development	√	√	X	√	0	√	0	0	x	0
		To minimize the risks arising from the extreme weather events such as floods, droughts and tropical storms.	√	√	√	0	0	√	0	√	X	0
		To promote conservation of natural resources and long term	√	√	X	√	0	√	0	√	X	√

		sustainability.										
2	Policy for Development of Renewable Energy for Power Generation, 2006	To increase the use of indigenous sources and diversify the energy mix.	√	0	X	0	0	0	0	0	√	0
		To ensure human health and environmental protection by reducing the use of traditional biomass and fossil fuel electricity generation.	√	√	X	0	0	X	0	√	X	0
		Increase the deployment of renewable energy technologies 9,700 MW by 2030	√	0	X	0	0	0	0	0	X	0
3	National Resettlement Policy, 2002	To avoid minimize social impacts and involuntary resettlement from developmental activities	0	√	X	√	0	0	0	0	X	0
4	National Environmental Policy, 2005	Promote energy efficiency and the use of renewable resources.	√	√	X	√	0	x/√	0	√	√	√
		To ensure protection of regional and global environment.	√	√	X	√	0	√	0	√	X	√
		Conservation, protection and sustainable use of biodiversity.	√	√	X	√	0	√	0	0	X	√
		Prevent and reduce air and noise pollution.	√	√	X	√	0	√	√	0	X	√
5	National Disaster Reduction Policy, 2013	Promoting development planning that considers and addresses disaster risks alongside environmental and climate change concerns	√	√	X	√	0	√	0	√	X	√

6	National Drinking Water Policy, 2009	To ensure protection and conservation of water resources	√	√	X	√	0	0	0	√	X	√
7	National Wetlands Policy, Final draft 2009	Conservation and sustainable use of wetlands	√	√	X	√	0	0	0	√	X	√
8	National Biodiversity Action Plan, 2000	Sustainable use of biological resources and the maintenance of biodiversity	√	√	x	√	0	√	0	√	X	√
10	Natural Gas Allocation and Management Policy, 2005	Assured gas supply to all existing consumer in Power Sectors will be on nine months basis and for remaining period, gas supply will be on the best effort basis	X	0	√	√	0	√	√	√	X	√
11	Petroleum Exploration and Production Policy, 2012	To accelerate E&P activities in Pakistan with a view to achieve maximum self-sufficiency in energy by increasing oil and gas production.	√	X	X	√	0	√	√	√	√	√
12	Energy Security and Affordability Annual Plan 2014-2015	Tap Pakistan's huge potential for alternative energy.	√	√	X	0	0	0	√	0	√	0

Compatible √, incompatible X, No link 0

4.4.1 National Climate Change Policy 2012

The national climate change policy is committed to integrate climate change in the vulnerable sectors of the economy to ensure climate resilient development and to minimize risk arising from the extreme events floods, droughts and tropical storms. The policy is also devoted to conserve the national resources and long term sustainability. The National Power Policy 2013 lacks the climate change integration, adaptation and mitigation in the power sector. The energy sector is contributing 28% of GHGs and it is one of the most vulnerable sectors to the negative impacts of climate change. Electricity generation of 38.1% from coal will produce more GHGs and will affect the hydel generation of electricity as the country's glaciers are melting at an alarming rate. This will enhance the extreme events like floods, droughts and tropical cyclone.

4.4.2 Policy for Development of Renewable Energy for Power Generation, 2006

The policy is dedicated to protect human health and environmental protection by reducing the traditional electricity generation from fossil fuel and biomass and also to increase the renewable share (excluding the hydel) in the national energy mix to 9700MW by 2030. The current fossil fuel share in the power generation is 68% which will be reduce to almost 49% including the major share of coal 38.1%. This will produce negative impacts on the human health and environment as the Pakistani coal has a high sulphur content. The National Power Policy 2013 has not that interest for the utilization of renewable energy but the national power system expansion has several wind and solar projects. The national power expansion plan has projected that 5000 MW will be generated from wind in contrast with committed generation of 9700MW in renewable energy policy.

4.4.3 National Resettlement Policy, 2002

The National Resettlement Policy is committed to avoid, minimize social impacts and involuntary resettlement from developmental activities on the other hand the National Power Policy 2013 is keen to utilize hydel and coal for the generation of power. The construction of such a huge number of dams (23 WAPDA and 18 IPP) will force the people to migrate from the project areas. On the other hand it will also cause some social impacts like Kalabagh dam.

4.4.4 National Environmental Policy, 2005

The national policy is keen to protect biodiversity, regional and global environment. To reduce air and noise pollution, promote the use of renewable resources. According to the NPSEP 2011-2030 the power demand will be 98,120 MW consisting of 35.7% of hydro power, 38.1% of steam turbines using Thar coal, 10.3% of CCGT, 6.7% of nuclear, 2% of interconnections, 7.2% from gas turbines and renewable energy sources. This energy mix has a small portion of renewable energy only 5000WM which is very negligible as compare to the Pakistan renewable energy potential. The construction of dams and the use of coal will pose threats to the biodiversity and air quality.

4.4.5 National Disaster Reduction Policy, 2012

The national disaster reduction policy is dedicated to promote development planning that considers and addresses disaster risks alongside environmental and climate change concerns. The national PPs are devoted to utilize hydel and coal more as compare to the other power generation options. The construction of dams will reduce risks of floods but on the other hand the utilization of coal will produce more GHGs which will affect the generation of hydel capacity.

4.4.6 National Wetlands Policy, Final draft 2009

The policy is devoted for the conservation and sustainable use of wetlands. The construction of dams as planned in the NPSEP has negative impacts on the wetlands. As the construction will divert water flow and water dependent habitats will become disappear and will result in biodiversity loss. On the other hand electricity generation from nuclear which is 6.7 % will pose threats to the marine environment.

4.4.7 Natural Gas Allocation and Management Policy, 2005

Pakistan being the bigger customer of the gas has complete asset capability of 282 trillion cubic feet with recoverable stores 24 trillion cubic feet and creation of very nearly 4 billion cubic feet every day. Gas stores are exhausting and if gas utilization develops every year even at moderate rates, the present recoverable store will generally be depleted by 2025. As projected in the NPSEP 7370MW will be produced from natural gas. There is inconsistency between the power system expansion plan and natural gas allocation and

management policy because the under the natural gas allocation policy gas supply to power sector will remain only for nine months and the gas resources will be exhausted by 2025. On the other hand CNG vehicles are growing day by day there are 2.7 million CNG converted vehicles. This increase will further limit gas supply to the power sector.

4.4.8 Petroleum Exploration and Production Policy, 2012

The policy is keen to speed up E&P activities in Pakistan with an opinion to attain maximum independence in energy by increasing oil and gas production. On the other hand the National Power Policy 2013 is committed to utilize inexpensive resources of coal and hydel.

4.4.9 Energy Security and Affordability Annual Plan 2014-2015

The plan is devoted to tap Pakistan's huge potential for alternative energy while the National Power Policy 2013 lacks such commitment. On the other hand NPSEP is projected to utilize a small portion 7370MW from wind out of more than 300000MW, and solar potential of 2.9 million MW.

4.4.10 National Biodiversity Action Plan, 2000

NBAP is committed to maintain biodiversity. The projected power generation mix is will affect biological diversity at project level. The generation of such huge numbers of dams will affect flora and fauna directly at project level.

4.6 Compatibility of National Power Policy, National Power System Expansion Plan 2011-2030 Objectives with Related International Agreements

The National Power Policy and National Power System Expansion Plan 2011-2030 objectives are tested against the international agreements to know the possible impacts and incompatibility. Kyoto protocol is not considered as Pakistan is a developing country so it is not obligatory. Following is the detail assessment summary.

Table No. 4.5 Compatibility of National Power Policy, National Power System Expansion Plan 2011-2030 Objectives with Related International Agreements

International commitments	**Description**	**Implication for Power PP**
Ramsar Convention on Wetlands	Conservation and wise use of all wetlands through local. Regional, national actions and international cooperation.	The NPP and NPSEP have both positive and negative impacts on the water resources. The PPs must reduce the negative impacts and enhance the positive impacts.
Convention of Migratory Species	Conservation and protection of terrestrial. Aquatic and migratory bird's species.	The PP have no significant impact on the birds because the projected wind power generation is about 5 percent by 2030. The main threats to birds is from wind power generation government has to look for mitigation measures at project level.
Convention on Law of Seas	Sustainable and efficient use of seas and oceans. Protection and conservation of marine resources.	The import of oils, gas pipeline with Qatar and offshore wind farms could result to the marine environment.
Convention on Biological Diversity	Conservation, protection and sustainable use of biodiversity. The fair and equitable sharing of the benefits arising out of the utilization of genetic resources	The PP have direct and indirect impacts on the biodiversity. The PP should be aware of the endangered and vulnerable species including marine species.
United Nations Convention to Combat Desertification	To switch and counteract desertification/land debasement and to alleviate the impacts of droughts in influenced territories, in order to support poverty reduction and environmental sustainability	Pakistan is a water deficient country. The projected power generation mix has both positive and negative impacts. However government has to enhance the positive impacts.
United Nation Framework Convention on Climate Change (UNFCCC)	Stabilization of greenhouse gas concentration in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.	The projected power generation mix has the potential to increase the GHGs concentration. Shift from gas to coal will increase the GHGs concentration.

4.7 Compatibility of SEA and National Power Policy, National Power System Expansion Plan 2011-2030 Objectives

The purpose of testing the PP objectives against the SEA objectives is to look for potential synergies and inconsistencies between what the PP are trying to achieve and main concern for environmental management. This is significant to ensure that the PP is in line with the environmental objectives.

Table No. 4.6 Compatibility of SEA and National Power Policy, National Power System Expansion Plan 2011-2030 Objectives

S.no	SEA objectives	PP Objectives									
		Build a power generation capacity that meets the needs in a sustainable manner	Create a culture of energy conservation and responsibility	Use of inexpensive indigenous resources such as coal (Thar coal) and hydel	Promote efficiency in power generation	Minimize financial losses across the system	Minimize pilferage and adulteration in fuel supply	Align the ministries involved in the energy sector and improve the governance	Minimize inefficiencies in the distribution system	To meet the expected load up to the year 2030 by utilizing the available resources	Create a cutting edge transmission network
1	To reduce emissions in accordance with the NEQs and international agreements	√	√	X/√	√	0	√	√	√	X	√
2	To avoid land contamination during the transportation and construction activities	√	√	X	√	0	√	√	√	X	√
3	Preserve historic buildings, monuments, archaeological sites and other culturally important features	√	√	X	0	√	√	√	√	X	√
4	Promote generation of energy from renewable resources	√	√	√/x	√	0	0	√	√	X	√
5	Reduce greenhouse gases emissions	√	√	√/x	√	0	√	√	√	X	√

	from the power sector in compliance with the national targets and international agreements										
6	Reduce pollution to the marine and fresh water environment from power generation	√	√	x	√	0	√	√	√	X	√
7	To reduce negative health impacts	√	√	X	√	0	√	√	√	X	√
8	To avoid damages to biodiversity (including terrestrial and marine) in line with national objectives and international agreements	√	√	X	√	0	√	√	√	X	√
9	To achieve national and international developmental goals in a sustainable way	√	√	√	√	√	√	√	√	√	√
10	To involve the vulnerable community and general public at an early stage of planning	√	√	√	0	0	0	√	√	√	0

4.7.1 Incompatibilities:

Overall objectives of the NPP and NPSEP 2011-2030 are compatible with the SEA objectives. Following PP objectives are the most incompatible with most of the SEA objectives.

Policy objective 3: *To generate inexpensive and affordable electricity for domestic, commercial, and industrial use by using indigenous resources such as coal (Thar coal) and hydel.*

Plan objective: *To meet the expected load up to the year 2030 by utilizing the available resources.*

SEAO-1: The above objectives are not compatible with the SEA objective. Coal is the dirtiest fossil fuel it produces 2.08 pounds of CO_2 per kWh as compare to natural gas 1.22 pounds CO_2 per kWh and distillate oil 1.81 pounds CO_2 per kWh (U.S Energy Information Administration, 2014). By 2030 the government will produce 37383.72 MW (38.1 %) of electricity from coal. This utilization of coal for power generation will cause more air emission.

SEAO-2: According to the NPSEP 2011-2030 the electricity demand will be 98,120 MW consisting of 35.7% of hydro power, 38.1% of steam turbines using Thar coal, 10.3% of CCGT, 6.7% of nuclear, 2% of interconnections, 7.2% from gas turbines and renewable energy sources. The construction of dams, extraction of coal, transportation of coal and waste disposal from power plants will contaminate land and soil.

SEAO-3: The construction of 43 new dams has the potential to affect archeological sites at the project level. The utilization of coal for power generation will affect the air quality and eventually acid rain will affect the historic buildings, monuments, archaeological sites and other culturally important features.

SEAO-4: This incompatible with the above PP objectives. The power policy is committed to generate electricity from indigenous resources specially the Thar coal but lack any aspiration to utilize renewable energy like wind and solar. On the other hand the NPSEP 2011-2030 has projected to generate only 5000 MW from wind, although Pakistan has more than 300000MW of wind, and of 2.9 million MW solar potential.

SEAO-5: Pakistan is a small GHGs producer. Its share is 0.8 % in total global GHGs. In June 2014 the share of thermal electricity was 67.97%. According to the NPSEP 2011-2030 the share of thermal will be reduces to 51% including a major portion of coal 38.1% which is the dirtiest fossil fuel. The generation of 37383.72 MW from coal will increase the GHGs. This projected by the planning commission of Pakistan that the energy sector will be producing 2685 Mt CO_2 equivalent by 2050.

SEAO-6: The construction 43 new dams as planned in the NPSEP 2011-2030. This will divert the flow and will cause serious threats to the fresh water life. On the other the new nuclear power plants will affect the marine life.

SEAO-7: The above PP objectives are incompatible with SEA objective because the planned power generation mix has the potential to affect human life negatively. The major concern will be regarding the coal's extraction and emission from coal power plants as they will produce CO_2, CO, NOx, SOx, and heavy metals which are injurious to human health.

SEAO-7: The NPP has no clear objective regarding the protection and conservation of biodiversity. The planned power generation mix for 2011-2030 has the potential to affect the biodiversity both indirectly and directly. The construction of dams, the utilization of coal and nuclear energy will affect the aquatic and terrestrial flora and fauna.

4.8 Impact Assessment

The assessment of impact is centered on the likelihood of the impact occurrence, scale of the impact, duration, reversibility, transboundary dimension, and the certainty of impact prediction. Each objective of the national power policy and national power system expansion plan was assessed against the SEA objective. Table 8.1 defines the assessment framework and the symbols used to represent the different types of impact.

Table No. 4.7 Impact assessment key

Impact character	Symbol	Explanation
Probability	VP	Impact very likely to occur
	P	Impact likely to occur
Scale	++	Large positive impact
	+	Positive impact
	0	No impact
	-	Negative impact
	--	Large negative impact
Direct / Indirect	I	Indirect impact
	D	Direct impact
Frequency / duration	LT	Long term
	ST	Short term
Trans boundary aspect	TR	Possible trans boundary effects
Uncertainty	?	Impact uncertain

Table No. 4.8 Impact assessment

Policy Objective 1: Build a power generation capacity that meets the needs in a sustainable manner
Measures:

- Target power and gas subsidy directly only at the abject poor.
- Provide more expensive but dedicated electricity to users utilizing captive power and generators.
- Phase out subsidy over period of three years.
- Retire circular debt immediately and clear GST refunds.
- Set maximum delay limit for payables (RFO 45-60 days / Gas 30-45 days).
- Provide financing to plants that lie dormant due to lack of funds or disputes.
- Bring pipeline projects online on war footing.
- Prioritize projects that can be brought online in two to three years, particular coal, run-of-the-river and bio-mass project.
- Assign key project manager from Ministry of Water and Power to each pipeline project with the sole responsibility of ensuring project comes online.

SEA Objectives	Indicator	Symbol	Impacts	Mitigations
To reduce emissions in accordance with the NEQs and international agreements	• Emission values from the power sector • Consistency in air parameters with NEQs	P - D LT	The policy measures indicate no such commitment to reduce emission or increase the efficiency of the existing power plants. The present scenario prevails that it has a negative impact on the air quality.	The existing power plants needs to go through rehabilitation and up gradation. The thermal and coal power needs to make sure the carbon capturing and efficient use of fuel.
To avoid land contamination during the transportation and construction activities	• Land contamination at specific sites at project level; • Number of oil spill incidents	P -/? D LT	Negative impacts are expected mainly because of coal and oil exploration and transportation.	The policy needs to incorporate measures for the land and soil protection.
Preserve historic buildings, monuments, archaeological sites and	• Number of operations located	P -	Historical buildings, monuments and	The existing power plants needs to go through

other culturally important features	away from cultural heritage sites / areas or areas with known cultural / archaeological remains • Status and number archaeological sites	D/I LT	archaeological sites are expected to be affected directly by the project activities. Indirectly by the air emission from thermal power plants.	rehabilitation and up gradation. The thermal and coal power needs to make sure the carbon capturing and efficient use of fuel.
Promote generation of energy from renewable resources	• Number of projects, funds and initiatives implemented that support renewable sources • Hazardous waste produced by energy infrastructure • Biofuel consumption (increase)	0	The policy has no specific objective and target for the utilization of the renewable resources.	The policy has to include target for the utilization of renewable energy at least 30% by 2030. The government has to precisely explore the potential of renewable energy of Pakistan.
Reduce greenhouse gases emissions from the power sector in compliance with the national targets and international agreements	• Emissions of greenhouse gases from energy • Increase in the use of renewable energy resources	P - D LT	The policy measures indicate no such commitment to reduce emission or increase the efficiency of the existing power plants. The present scenario prevails that it has a negative impact on the air quality.	The existing power plants needs to go through rehabilitation and up gradation. The thermal and coal power needs to make sure the carbon capturing and efficient use of fuel.
Reduce pollution to the marine and fresh water environment from power	• Quality of the marine	P -	New nuclear power plants are expected to	Nuclear power plant generation plans and

generation	environment; • Quality of groundwater; • Number of water pollution accidents; • Status of water availability per capita, per sector and per dependent habitat	D LT	have negative impacts on marine environment.	strategies must include national and international health standards.
To reduce negative health impacts	• Emission values from the power sector • Number patients suffering from air and water related diseases in the vicinity of power generation activities • Rate of mortality • size of population and changes in demography • years of healthy life expectancy / infant mortality rate	P - D LT	To meet the energy demand different projects will be executed that will result in indirect or direct health impacts.	The vulnerable community needs to be involve in the planning process. Most efficient and new technologies needs to be use for power generation.
To avoid damages to biodiversity (including terrestrial and marine) in line with national objectives and	• Status, percentage and coverage of protected areas,	P - D/I	To meet the energy demand different projects will be executed that will	Project level EiAs needs to be carried out precisely in those areas which are

international agreements	• Status and number of species • Status of the forest cover	LT	result in indirect or direct harm to biodiversity.	ecologically important.
To achieve national and international developmental goals in a sustainable way	• Status of the life style • Status of the GDP and NDP	P + D LT	Fulfilling the energy needs of the country will result in the economic development of the country.	
To involve the vulnerable community and general public at an early stage of planning	• Number of consultation studies and public involvement in the power sector PPPs	?	Policy does not address public participation	

Policy Objective 2: Create a culture of energy conservation and responsibility
Measures:

- Set energy conservation and product labeling standards.
- Ban imports of non-efficient consumer electronics in Pakistan.
- Provide Pakistani manufacturers three year time limit to bring products up to par with efficiency.
- Impose specific timings and restrictions for Shopping, and other recreational activities, billboard lighting, street lighting, commercial lighting, neon lighting, air conditioning.
- Introduce 'Time of Use' meters that charges different rates for peak and off-peak electricity usage.
- Provide more expensive but dedicated electricity to heavy users utilizing captive power plants and generators (commercial and residential).
- Phase out subsidy over period of three years.
- Pass true economic cost of electricity generation to consumers over time Maintain subsidy for abject poor.

SEA Objectives	**Indicator**	**Symbol**	**Impacts**	**Mitigation**
To reduce emissions in accordance with the NEQs and international agreements	• Emission values from the power sector • Consistency in air parameters with	P + D LT	Energy conservation and responsibility will reduce the demand for more generation of electricity thus reducing the air	

	NEQs		emission	
To avoid land contamination during the transportation and construction activities	• Land contamination at specific sites at project level; • Number of oil spill incidents	0		
Preserve historic buildings, monuments, archaeological sites and other culturally important features	• Number of operations located away from cultural heritage sites / areas or areas with known cultural / archaeological remains • Status and number archaeological sites	P + I LT	Energy conservation and responsibility will reduce the demand for more generation of electricity thus reducing the air emission and acid rain	
Promote generation of energy from renewable resources	• Number of projects, funds and initiatives implemented that support renewable sources • Hazardous waste produced by energy infrastructure • Biofuel consumption (increase)	0		
Reduce greenhouse gases emissions from the power sector in compliance	• Emissions of greenhouse gases	P +	Energy conservation and responsibility will reduce	

with the national targets and international agreements	from energy • Increase in the use of renewable energy resources	D LT	the demand for more generation of electricity thus reducing the air emission	
Reduce pollution to the marine and fresh water environment from power generation	• Quality of the marine environment; • Quality of groundwater; • Number of water pollution accidents; • Status of water availability per capita, per sector and per dependent habitat	P + D LT	Do	
To reduce negative health impacts	• Emission values from the power sector • Number patients suffering from air and water related diseases in the vicinity of power generation activities • Rate of mortality • size of population and changes in demography • years of healthy life expectancy /	P + D LT	Do	

	infant mortality rate			
To avoid damages to biodiversity (including terrestrial and marine) in line with national objectives and international agreements	• Status, percentage and coverage of protected areas, • Status and number of species • Status of the forest cover	P + I LT	Do	
To achieve national and international developmental goals in a sustainable way	• Status of the life style • Status of the GDP and NDP	?		
To involve the vulnerable community and general public at an early stage of planning	• Number of consultation studies and public involvement in the power sector PPPs	?	There is no obvious relation.	To involve the vulnerable community and general public at an early stage of planning
Policy objective 3: Ensure the generation of inexpensive and affordable electricity for domestic, commercial, and industrial use by using indigenous resources such as coal (Thar coal) and hydel. **Measures:** • Identify expensive RFO and HSD plants and convert them to gas or coal. • Shift tariff incentives towards low cost energy sources (hydel, gas, coal, nuclear, biomass, etc.). • Proliferate mining across the country and expedite coal projects at Thar blocks • Increase price for gas consumption for all users except for poor residential users. • Reduce utilization of gas in CNG and UFG in particular-10% gas diversion can generate 2,000 MW. • Divert gas to the power sector and ensure firm supply to the power plants				
SEA Objectives	**Indicator**	**Symbol**	**Impacts**	**Mitigation**
To avoid land contamination during the transportation and construction activities	• Land contamination at specific sites at	?		

	project level; • Number of oil spill incidents			
Preserve historic buildings, monuments, archaeological sites and other culturally important features	• Number of operations located away from cultural heritage sites / areas or areas with known cultural / archaeological remains • Status and number archaeological sites	P - D LT	The policy is committed to utilize the Thar coal for power generation which will increase emission into air resulting acid rain	The government should make it sure to include the environmental cost in each coal power plant. There must be monitoring system to make sure the emissions are within the limits. The thermal and coal power needs to make sure the carbon capturing and efficient use of fuel.
Promote generation of energy from renewable resources	• Number of projects, funds and initiatives implemented that support renewable sources • Hazardous waste produced by energy infrastructure • Biofuel consumption (increase)	0		
Reduce greenhouse gases emissions from the power sector in compliance with the national targets and international agreements	• Emissions of greenhouse gases from energy • Increase in the use of renewable energy resources	P - D LT	The policy is committed to utilize the Thar coal for power generation which will increase emission into air	The government should make it sure to include the environmental cost in each coal power plant. There must be monitoring system to make sure the

				emissions are within the limits. The thermal and coal power needs to make sure the carbon capturing and efficient use of fuel.
Reduce pollution to the marine and fresh water environment from power generation	• Quality of the marine environment; • Quality of groundwater; • Number of water pollution accidents; • Status of water availability per capita, per sector and per dependent habitat	P - D LT	The national power policy is committed to utilize hydel power potential by constructing huge number of dams. The construction activities have negative impacts on fresh water life.	Care should be taken not to disturb or reduce the flow of water to nationally important wetlands.
To reduce negative health impacts	• Emission values from the power sector • Number patients suffering from air and water related diseases in the vicinity of power generation activities • Rate of mortality • size of population and changes in demography • years of healthy	P - D/I LT	The policy is committed to utilize the Thar coal for power generation which will increase emission into air	The government should make it sure to include the environmental cost in each coal power plant. There must be monitoring system to make sure the emissions are within the limits. The thermal and coal power needs to make sure the carbon capturing and efficient use of fuel.

	life expectancy / infant mortality rate			
To avoid damages to biodiversity (including terrestrial and marine) in line with national objectives and international agreements	• Status, percentage and coverage of protected areas, • Status and number of species • Status of the forest cover	P - D LT	The national power policy is committed to utilize hydel power potential by constructing huge number of dams. The construction activities have negative impacts on biodiversity	Care should be taken not to disturb or reduce the flow of water to nationally important wetlands.
To achieve national and international developmental goals in a sustainable way	• Status of the life style • Status of the GDP and NDP	P + D LT	Fulfilling the energy needs of the country will result in the economic development of the country.	
To involve the vulnerable community and general public at an early stage of planning	• Number of consultation studies and public involvement in the power sector PPPs	?	There is no obvious relation.	To involve the vulnerable community and general public at an early stage of planning
Policy objective 4: Minimize pilferage and adulteration in the fuel supply to improve productivity **Measures:** • Reduce allocation to GENCOs until they are at higher efficiency levels • Move fuel allocation from GENCOs to IPPs • Sign performance contracts with GENCOs, PSO, and fuel transporters • Open fuel procurement contracts through tendering to eliminate role of single supplier • Eliminate trucking and open decanting by building pipelines (for Muzaffargarh TPS) • Measure the quantity and quality of fuel moving from the port to GENCO • Appropriate full economic, value added cost of quality or quantity loss to the end receiver				
SEA Objectives	**Indicator**	**Symbol**	**Impacts**	**Mitigation**
To reduce emissions in accordance	• Emission values	P	Minimization of	

with the NEQs and international agreements	from the power sector • Consistency in air parameters with NEQs	+ D LT	pilferage and adulteration in the fuel supply will also reduce air pollution from thermal power plants.	
To avoid land contamination during the transportation and construction activities	• Land contamination at specific sites at project level; • Number of oil spill incidents	?		
Preserve historic buildings, monuments, archaeological sites and other culturally important features	• Number of operations located away from cultural heritage sites / areas or areas with known cultural / archaeological remains • Status and number archaeological sites	?	Minimization of pilferage and adulteration in the fuel supply has no obvious impacts however the reduction of acid rain inducing agents will have positive impacts.	
Promote generation of energy from renewable resources	• Number of projects, funds and initiatives implemented that support renewable sources • Hazardous waste produced by energy infrastructure • Biofuel	0	Has no obvious link	

	consumption (increase)			
Reduce greenhouse gases emissions from the power sector in compliance with the national targets and international agreements	• Emissions of greenhouse gases from energy • Increase in the use of renewable energy resources	P + D LT	Minimization of pilferage and adulteration in the fuel supply will also reduce air pollution from thermal power plants.	
Reduce pollution to the marine and fresh water environment from power generation	• Quality of the marine environment; • Quality of groundwater; • Number of water pollution accidents; • Status of water availability per capita, per sector and per dependent habitat	P +/? D LT	Minimization of pilferage and adulteration in the fuel supply will also reduce air pollution from thermal power plants thus reducing the risk of acid rain formation. However the impact is still uncertain more study is needed at the project level.	
To reduce negative health impacts	• Emission values from the power sector • Number patients suffering from air and water related diseases in the vicinity of power generation activities • Rate of mortality • size of population	P + D/I LT	Minimization of pilferage and adulteration in the fuel supply will also reduce air pollution from thermal power plants thus reducing harm to human health.	

	and changes in demography • years of healthy life expectancy / infant mortality rate			
To avoid damages to biodiversity (including terrestrial and marine) in line with national objectives and international agreements	• Status, percentage and coverage of protected areas, • Status and number of species • Status of the forest cover	?		
To achieve national and international developmental goals in a sustainable way	• Status of the life style • Status of the GDP and NDP	P + D LT	Minimization of pilferage and adulteration in the fuel supply will result in the better generation and the cost of electricity will also reduce.	
To involve the vulnerable community and general public at an early stage of planning	• Number of consultation studies and public involvement in the power sector PPPs	?		
Policy objective 5: Promote world class efficiency in power generation **Measures:** • Establish plant efficiency through heat rate testing. • Prioritize and allocate fuel based upon the efficiency levels. • Make allocations and efficiency levels transparent online. • Monitor the efficiency of these plants on a continuous basis. • Either privatize; or lease GENCOs to private sector on the basis of O&M contracts.				

• Pilot two GENCOS immediately. • Prepare the remaining GENCOS for subsequent privatization through corporatization.				
SEA Objectives	**Indicator**	**Symbol**	**Impacts**	**Mitigation**
To reduce emissions in accordance with the NEQs and international agreements	• Emission values from the power sector • Consistency in air parameters with NEQs	P + D LT	Promoting efficiency in power generation will reduce demand for more power generation, Efficient power generation will also reduce emission to air from power plants.	
To avoid land contamination during the transportation and construction activities	• Land contamination at specific sites at project level; • Number of oil spill incidents	0	No obvious link	
Preserve historic buildings, monuments, archaeological sites and other culturally important features	• Number of operations located away from cultural heritage sites / areas or areas with known cultural / archaeological remains • Status and number archaeological sites	P + I LT	Efficient power generation will reduce emission to air from power plants thus reducing the risk of acid rain.	
Promote generation of energy from renewable resources	• Number of projects, funds and initiatives implemented that	0		

	support renewable sources • Hazardous waste produced by energy infrastructure • Biofuel consumption (increase)			
Reduce greenhouse gases emissions from the power sector in compliance with the national targets and international agreements	• Emissions of greenhouse gases from energy • Increase in the use of renewable energy resources	P + D LT	Efficient power generation will reduce emission to air from power plants.	
Reduce pollution to the marine and fresh water environment from power generation	• Quality of the marine environment; • Quality of groundwater; • Number of water pollution accidents; • Status of water availability per capita, per sector and per dependent habitat	P + I LT	Efficient power generation will reduce emission to air from power plants thus reducing the risk of acid rain.	
To reduce negative health impacts	• Emission values from the power sector • Number patients suffering from air	P + D/I LT	Efficient power generation will reduce emission to air from power plants thus reducing risk to human	

	and water related diseases in the vicinity of power generation activities • Rate of mortality • size of population and changes in demography • years of healthy life expectancy / infant mortality rate		health.	
To avoid damages to biodiversity (including terrestrial and marine) in line with national objectives and international agreements	• Status, percentage and coverage of protected areas, • Status and number of species • Status of the forest cover	?		
To achieve national and international developmental goals in a sustainable way	• Status of the life style • Status of the GDP and NDP	P + D LT	Efficient power generation will reduce emission to air from power plants and the cost of power generation will also be lessen	
To involve the vulnerable community and general public at an early stage of planning	• Number of consultation studies and public involvement in the power sector PPPs	0	Policy does not address public participation	
Policy objective 6: Create a world class transmission and distribution network **Measures:**				

- Sign performance contracts with NTDC 2.5% are NEPRA allowed losses; 3.6% are the current existing losses.
- Dispatch based upon economic order.
- Install transmission effectiveness analysis software and hardware to optimize transmission.
- Build future medium /small sized power plants closer to load centers to minimize line losses.
- Expand high voltage transmission lines further North beyond Ravat.
- Strengthen 220KV rings around large cities to minimize losses.
- Redesign merit order to also take into consideration transmission losses of plants.
- Create a new business model based upon whole sales transactions, exchanges and wheeling charges.
- Incentivize the private sector to make investments in transmission, especially for the new generation plants placed off grid or in areas where the grid is weak.

SEA Objectives	**Indicator**	**Symbol**	**Impacts**	**Mitigation**
To reduce emissions in accordance with the NEQs and international agreements	• Emission values from the power sector • Consistency in air parameters with NEQs	P + D LT	Improvement in the transmission and distribution system will improve the efficiency of existing power plant and will reduce need for the new power plants thus it has positive impact	
To avoid land contamination during the transportation and construction activities	• Land contamination at specific sites at project level; • Number of oil spill incidents	0		
Preserve historic buildings, monuments, archaeological sites and other culturally important features	• Number of operations located away from cultural heritage sites / areas or areas with	P + I LT	Improvement in the transmission and distribution system will improve the efficiency of existing power plant and will reduce need for the	

	known cultural / archaeological remains • Status and number archaeological sites		construction of new power plants thus it will reduce emission into the air resulting in the lessen risk of acid rain	
Promote generation of energy from renewable resources	• Number of projects, funds and initiatives implemented that support renewable sources • Hazardous waste produced by energy infrastructure • Biofuel consumption (increase)	0		
Reduce greenhouse gases emissions from the power sector in compliance with the national targets and international agreements	• Emissions of greenhouse gases from energy • Increase in the use of renewable energy resources	P + D LT	Improvement in the transmission and distribution system will improve the efficiency of existing power plant and will reduce need for the construction of new power plants thus it will reduce emission into the air	
Reduce pollution to the marine and fresh water environment from power generation	• Quality of the marine environment; • Quality of	P + I LT	Improvement in the transmission and distribution system will improve the efficiency of	

	groundwater; • Number of water pollution accidents; • Status of water availability per capita, per sector and per dependent habitat		existing power plant and will reduce need for the construction of new power plants thus it will reduce emission into the air resulting in the lessen risk of acid rain	
To reduce negative health impacts	• Emission values from the power sector • Number patients suffering from air and water related diseases in the vicinity of power generation activities • Rate of mortality • size of population and changes in demography • years of healthy life expectancy / infant mortality rate	P + D/I LT	Improvement in the transmission and distribution system will improve the efficiency of existing power plant and will reduce need for the construction of new power plants thus it will reduce emission into the air resulting in the lessen risk to human health	
To avoid damages to biodiversity (including terrestrial and marine) in line with national objectives and international agreements	• Status, percentage and coverage of protected areas, • Status and number of species	?	Improvement in the transmission and distribution system will improve the efficiency of existing power plant and	

	• Status of the forest cover		will reduce need for the construction of new power plants thus it will reduce emission into the air resulting in the lessen risk of acid rain	
To achieve national and international developmental goals in a sustainable way	• Status of the life style • Status of the GDP and NDP	P + D LT	Improvement in the transmission and distribution system will improve the efficiency of existing power plant and will reduce need for the construction of new power plants	
To involve the vulnerable community and general public at an early stage of planning	• Number of consultation studies and public involvement in the power sector PPPs	0	Policy does not address public participation	
Policy objective 7: Minimize inefficiencies in the distribution system. **Measures:** • Sign performance contracts with the key stakeholders / heads of the distribution companies (DISCOs) to ensure their accountability with respects to effective distribution. • Reduction in distribution losses (technical losses as well as theft related losses) • Full collections of distribution companies¡¦ receivables from consumers using ATC index • Use Smart Meters to develop an online monitoring system for CDPs, feeders, transformers and consumer end meters. • Manage profit and loss accounts at the feeder level. • Hold XEN accountable for P&L and reward or remove. • Privatize a limited number of DISCOs as pilot and document key learnings. • Devolve the P&L of the remaining DISCOs to the feeder level and hold XEN accountable to improve performance. • Privatize all DISCOs over a period of time.				
SEA Objectives	**Indicator**	**Symbol**	**Impacts**	**Mitigation**

To reduce emissions in accordance with the NEQs and international agreements	• Emission values from the power sector • Consistency in air parameters with NEQs	P + D LT	Improvement in the distribution system will improve the efficiency of existing power plant and will reduce need for the construction of new power plants. This will reduce air emission from power sector.	
To avoid land contamination during the transportation and construction activities	• Land contamination at specific sites at project level; • Number of oil spill incidents	0		
Preserve historic buildings, monuments, archaeological sites and other culturally important features	• Number of operations located away from cultural heritage sites / areas or areas with known cultural / archaeological remains • Status and number archaeological sites	P + I LT	Improvement in the distribution system will improve the efficiency of existing power plant and will reduce need for the construction of new power plants. This will reduce air emission from power sector resulting in the low risk of acid rain.	
Promote generation of energy from renewable resources	• Number of projects, funds and initiatives implemented that support renewable sources • Hazardous waste	0		

	produced by energy infrastructure • Biofuel consumption (increase)			
Reduce greenhouse gases emissions from the power sector in compliance with the national targets and international agreements	• Emissions of greenhouse gases from energy • Increase in the use of renewable energy resources	P + D LT	Improvement in the distribution system will improve the efficiency of existing power plant and will reduce need for the construction of new power plants. This will reduce air emission from power sector.	
Reduce pollution to the marine and fresh water environment from power generation	• Quality of the marine environment; • Quality of groundwater; • Number of water pollution accidents; • Status of water availability per capita, per sector and per dependent habitat	P + I LT	Improvement in the distribution system will improve the efficiency of existing power plant and will reduce need for the construction of new power plants. This will reduce air emission from power sector resulting in the low risk of acid rain.	
To reduce negative health impacts	• Emission values from the power sector • Number patients suffering from air	P + D/I LT	Improvement in the distribution system will improve the efficiency of existing power plant and will reduce need for the	

	and water related diseases in the vicinity of power generation activities • Rate of mortality • size of population and changes in demography • years of healthy life expectancy / infant mortality rate		construction of new power plants. This will reduce air emission from power sector resulting in the low risk to human health	
To avoid damages to biodiversity (including terrestrial and marine) in line with national objectives and international agreements	• Status, percentage and coverage of protected areas, • Status and number of species • Status of the forest cover	?	Improvement in the distribution system will improve the efficiency of existing power plant and will reduce need for the construction of new power plants. This will reduce air emission from power sector resulting in the low risk of acid rain.	
To achieve national and international developmental goals in a sustainable way	• Status of the life style • Status of the GDP and NDP	P + D LT	Improvement in the distribution system will improve the efficiency of existing power plant and will reduce need for the construction of new power plants. This has a positive impact on the development	

To involve the vulnerable community and general public at an early stage of planning	• Number of consultation studies and public involvement in the power sector PPPs	0	Policy does not address public participation	

Policy objective 8: Minimize financial losses across the system

Measures:

- Automatically adjust already agreed upon amounts owed by provinces and government dept to power sector from the NFC award and department budget.
- Appoint independent, reliable adjuster to settle payment disputes with provinces and government departments within a period of three to six months
- Agree upon transparent procedure for future billing and collections
- Collect GST refunds from FBR and devise a mechanism to avoid future build ups
- Eliminate transmission and distribution theft
- Focus load shedding in areas where collections are low
- Pass legislation that allows for defaulters connections to be severed

SEA Objectives	**Indicator**	**Symbol**	**Impacts**	**Mitigation**
To reduce emissions in accordance with the NEQs and international agreements	• Emission values from the power sector • Consistency in air parameters with NEQs	0		
To avoid land contamination during the transportation and construction activities	• Land contamination at specific sites at project level; • Number of oil spill incidents	0		
Preserve historic buildings, monuments, archaeological sites and other culturally important features	• Number of operations located away from cultural	0		

	heritage sites / areas or areas with known cultural / archaeological remains • Status and number archaeological sites			
Promote generation of energy from renewable resources	• Number of projects, funds and initiatives implemented that support renewable sources • Hazardous waste produced by energy infrastructure • Biofuel consumption (increase)	0		
Reduce greenhouse gases emissions from the power sector in compliance with the national targets and international agreements	• Emissions of greenhouse gases from energy • Increase in the use of renewable energy resources	0		
Reduce pollution to the marine and fresh water environment from power generation	• Quality of the marine environment; • Quality of groundwater; • Number of water	0		

	pollution accidents; • Status of water availability per capita, per sector and per dependent habitat			
To reduce negative health impacts	• Emission values from the power sector • Number patients suffering from air and water related diseases in the vicinity of power generation activities • Rate of mortality • size of population and changes in demography • years of healthy life expectancy / infant mortality rate	0		
To avoid damages to biodiversity (including terrestrial and marine) in line with national objectives and international agreements	• Status, percentage and coverage of protected areas, • Status and number of species • Status of the forest cover	0		

To achieve national and international developmental goals in a sustainable way	• Status of the life style • Status of the GDP and NDP	P + D LT	Minimization of financial losses has positive impact on the national development	
To involve the vulnerable community and general public at an early stage of planning	• Number of consultation studies and public involvement in the power sector PPPs	0	Policy does not address public participation	
Policy objective 9: Align the ministries involved in the energy sector and improve the governance of all related federal and provincial departments as well as regulators **Measures:** • Notify the official coordination council between ministry of water and power, ministry of petroleum, ministry of finance, and the planning commission. • Ensure information integration between all ministries • Reform the structural and regulatory aspects of NEPRA and OGRA • Restructure ministry of water and power to strengthen function expertise • Create directorates for each function (Generation, Transmission and Distribution) • Ensure power sector reform PEPCO, CPRA and NTDC				
SEA Objectives	**Indicator**	**Symbol**	**Impacts**	**Mitigation**
To reduce emissions in accordance with the NEQs and international agreements	• Emission values from the power sector • Consistency in air parameters with NEQs	0		
To avoid land contamination during the transportation and construction activities	• Land contamination at specific sites at project level; • Number of oil spill incidents	0		

Preserve historic buildings, monuments, archaeological sites and other culturally important features	• Number of operations located away from cultural heritage sites / areas or areas with known cultural / archaeological remains • Status and number archaeological sites	0		
Promote generation of energy from renewable resources	• Number of projects, funds and initiatives implemented that support renewable sources • Hazardous waste produced by energy infrastructure • Biofuel consumption (increase)	0		
Reduce greenhouse gases emissions from the power sector in compliance with the national targets and international agreements	• Emissions of greenhouse gases from energy • Increase in the use of renewable energy resources	0		
Reduce pollution to the marine and fresh water environment from power generation	• Quality of the marine environment;	0		

	• Quality of groundwater; • Number of water pollution accidents; • Status of water availability per capita, per sector and per dependent habitat			
To reduce negative health impacts	• Emission values from the power sector • Number patients suffering from air and water related diseases in the vicinity of power generation activities • Rate of mortality • size of population and changes in demography • years of healthy life expectancy / infant mortality rate	0		
To avoid damages to biodiversity (including terrestrial and marine) in line with national objectives and international agreements	• Status, percentage and coverage of protected areas, • Status and number	0		

	of species • Status of the forest cover			
To achieve national and international developmental goals in a sustainable way	• Status of the life style • Status of the GDP and NDP	0		
To involve the vulnerable community and general public at an early stage of planning	• Number of consultation studies and public involvement in the power sector PPPs	0		
Plan objective : To meet the expected load up to the year 2030 by utilizing the available resources				
SEA Objectives	**Indicator**	**Symbol**	**Impacts**	**Mitigation**
To reduce emissions in accordance with the NEQs and international agreements	• Emission values from the power sector • Consistency in air parameters with NEQs	P - D LT	According to the NPSEP 2011-2030 the electricity demand will be 98,120 MW consisting of 35.7% of hydro power, 38.1% of steam turbines using Thar coal, 10.3% of CCGT, 6.7% of nuclear, 2% of interconnections, 7.2% from gas turbines and renewable energy sources. The utilization of coal at such amount will result in more air emission.	The existing power plants needs to go through rehabilitation and up gradation. The thermal and coal power needs to make sure the carbon capturing and efficient use of fuel.
To avoid land contamination during the transportation and construction activities	• Land contamination at specific sites at	P -/? D	As planned in national power system expansion plan 2011 – 2030, the	The policy needs to incorporate measures for the land and soil

	project level; • Number of oil spill incidents	LT	electricity demand will be 98,120 MWconsisting of 35.7% of hydro power, 38.1% of steam turbines using Thar coal, 10.3% of CCGT, 6.7% of nuclear, 2% of interconnections, 7.2% from gas turbines and renewable energy sources. This involve the construction of 43 new dams and several coal power plant. The construction of dams, extraction of coal, transportation of coal and waste disposal from power plants will contaminate land and soil.	protection. Project specific data is required to be critically examine before the execution of project. Special care should be taken during the transportation of coal.
Preserve historic buildings, monuments, archaeological sites and other culturally important features	• Number of operations located away from cultural heritage sites / areas or areas with known cultural / archaeological remains • Status and number archaeological sites	P - D/I LT	According to the NPSEP 2011-2030 the electricity demand will be 98,120 MW consisting of 35.7% of hydro power, 38.1% of steam turbines using Thar coal, 10.3% of CCGT, 6.7% of nuclear, 2% of interconnections, 7.2% from gas turbines and renewable energy	The existing power plants needs to go through rehabilitation and up gradation. The thermal and coal power needs to make sure the carbon capturing and efficient use of fuel.

			sources. The utilization of coal at such amount will result in more air emission. Thus increasing the risk of acid rain.	
Promote generation of energy from renewable resources	• Number of projects, funds and initiatives implemented that support renewable sources • Hazardous waste produced by energy infrastructure • Biofuel consumption (increase)	?		The policy has to include target for the utilization of renewable energy at least 30% by 2030. The government has to precisely explore the potential of renewable energy of Pakistan.
Reduce greenhouse gases emissions from the power sector in compliance with the national targets and international agreements	• Emissions of greenhouse gases from energy • Increase in the use of renewable energy resources	P - D LT	According to the NPSEP 2011-2030 the electricity demand will be 98,120 MW consisting of 35.7% of hydro power, 38.1% of steam turbines using Thar coal, 10.3% of CCGT, 6.7% of nuclear, 2% of interconnections, 7.2% from gas turbines and renewable energy sources. The utilization of coal at such amount	The existing power plants needs to go through rehabilitation and up gradation. The thermal and coal power needs to make sure the carbon capturing and efficient use of fuel.

			will result in more air emission.	
Reduce pollution to the marine and fresh water environment from power generation	• Quality of the marine environment; • Quality of groundwater; • Number of water pollution accidents; • Status of water availability per capita, per sector and per dependent habitat	P - D LT	According to the NPSEP 2011-2030 the electricity demand will be 98,120 MW consisting of 35.7% of hydro power, 38.1% of steam turbines using Thar coal, 10.3% of CCGT, 6.7% of nuclear, 2% of interconnections, 7.2% from gas turbines and renewable energy sources. The utilization of coal at such amount will result in more air emission. Thus increasing the risk of acid rain.	Nuclear power plant generation plans and strategies must include national and international health standards.
To reduce negative health impacts	• Emission values from the power sector • Number patients suffering from air and water related diseases in the vicinity of power generation activities • Rate of mortality • size of population and changes in	P - D LT	According to the NPSEP 2011-2030 the electricity demand will be 98,120 MW consisting of 35.7% of hydro power, 38.1% of steam turbines using Thar coal, 10.3% of CCGT, 6.7% of nuclear, 2% of interconnections, 7.2% from gas turbines and renewable energy sources. The utilization	The vulnerable community needs to be involve in the planning process. Most efficient and new technologies needs to be use for power generation.

	demography • years of healthy life expectancy / infant mortality rate		of coal at such amount will result in more air emission. Thus increasing the risk to human health.	
To avoid damages to biodiversity (including terrestrial and marine) in line with national objectives and international agreements	• Status, percentage and coverage of protected areas, • Status and number of species • Status of the forest cover	P - D/I LT	According to the NPSEP 2011-2030 the electricity demand will be 98,120 MW consisting of 35.7% of hydro power, 38.1% of steam turbines using Thar coal, 10.3% of CCGT, 6.7% of nuclear, 2% of interconnections, 7.2% from gas turbines and renewable energy sources. The utilization of coal at such amount will result in more air emission. Thus increasing the risk of acid rain. The construction of dams can also negatively affect the local flora and fauna specially the fresh water ecosystem.	Project level EiAs needs to be carried out precisely in those areas which are ecologically important.
To achieve national and international developmental goals in a sustainable way	• Status of the life style • Status of the GDP and NDP	P + D LT	To meet the energy demands will result in the country's development.	

To involve the vulnerable community and general public at an early stage of planning	• Number of consultation studies and public involvement in the power sector PPPs	?	Policy does not address public participation	

4.9 Alternatives

Government's priority areas and the overall goals and objectives for the development of the power sector are efficiency, competition and sustainability. The following options have been considered.

Option 1 – Do-nothing option, i.e.do not go ahead with the Policy

Option 2 – Priority given to efficiency

Option 3 – Priority given to competition

Option 4 – Priority given to sustainability

Option 5 – A balance between the three objectives - efficiency, competition and sustainability.

The do-nothing option implies that the current scenario would prevail. The 'do-nothing' option is a routine part of Strategic Environmental Assessment. It is undertaken in order to provide a benchmark against which changes that are proposed as part of a policy can be measured. As the power policy has already been executed and this is a post SEA so this option is not an option now. Following is the summary of different options. It gives an indication that if one of these options was chosen, then the relevant policy areas would be given priority. It also shows that if one of the objectives is given priority than the other two would suffer.

Table No. 4.11 Alternatives

Option 2 – efficiency	**Option 3 – competition**	**Option 4 – sustainability**
Measures in the following policy areas would be given primacy	Measures in the following policy areas would be given primacy	Measures in the following policy areas would be given primacy
Policy objective 5. Promote world class efficiency in power generation. *Policy objective 4.* Minimize pilferage and adulteration in fuel supply. *Policy objective 5.* Create a cutting edge transmission network. *Policy objective 7.* Minimize inefficiencies in the distribution system. *Policy objective 9.* Align the ministries involved in the energy sector and improve the governance of all related federal and provincial departments as well as regulators.	*Policy objective 3.* Ensure the generation of inexpensive and affordable electricity for domestic, commercial, and industrial use by using indigenous resources such as coal (Thar coal) and hydel. *Policy objective 5.* Promote world class efficiency in power generation. *Policy objective 8.* Minimize financial losses across the system. *Policy objective 9.* Align the ministries involved in the energy sector and improve the governance of all related federal and provincial departments as well as regulators.	*Policy objective 1.* Build a power generation capacity that can meet Pakistan's energy needs in a sustainable manner. *Policy objective 5.* Promote world class efficiency in power generation. *Policy objective 2.* Create a culture of energy conservation and responsibility. *Policy objective 3.* Ensure the generation of inexpensive and affordable electricity for domestic, commercial, and industrial use by using renewable resources. *Policy objective 9.* Align the ministries involved in the energy sector and improve the governance of all related federal and provincial departments as well as regulators.

The best option:

As mention earlier this SEA is a post assessment of the NPP and NPSEP 2011-2030. However the best option is number 5. This is the balance between the three objectives - efficiency, competition and sustainability. However the government has to invest more in the renewable resources. Pakistan has a great potential of wind energy about 50000 MW. Global share of renewable energy is expected to rise around 34% by 2030. Wind energy is estimated to rise from 5% in 2012 to 17% of installed capacity by 2030, leaving behind large-hydro (World Energy Council, 2013). If the government utilize only a small fraction from RE the present issues of power sector will be solved in a sustainable manner. It was concluded from the comparison of wind energy against coal that wind is cheaper, environment friendly and sustainable. The price of electricity produced from wind is low than the coal and in the future it will be cheaper with the advancement of wind energy technologies. The cost of power plant installation and operation is also lower as compared with the coal power plant. When it comes to the environmental concerns wind energy is clean and sustainable. Wind power plant does not require fuel so there is no fuel cost, no pollution and no resource depletion. According to the British Petroleum coal will lost for the next 110 years while wind will be there forever free of cost. Coal power plant generate 1,842 kWh per ton of coal while produces 2.08 lbs. of CO_2 per kWh. Apart from this coal power plants releases hot water as waste and produces NOx, CO, CO_2, Mercury, Lead, hydro carbons, Arsenic, SO_2, and particulate matter. There is a high level of human health cost associated with the coal extraction and transportation.

Table No. 4.10 Comparison between wind and coal power

Characteristics	**Wind**	**Coal**
Plant life	20 years (WMI)	30 years (UCSUSA)
Price of electricity (USD/kWh)	$0.08-0.20 (Energy information administration US)	$0.10-0.14 (Energy information administration US)
Total System Levelized Costs (2010 USD/MWh)	80.3 (Energy information administration US)	95.6 (Energy information administration US)
Air pollution	0	2,249 lbs/MWh of carbon dioxide, 13 lbs/MWh of sulfur dioxide, and 6 lbs/MWh of nitrogen oxides (US EPA, 2000)
Water pollution		Hot water
CO2 production (Lbs. CO_2 per kWh)	0	2.08 (Energy information administration US)
Fuel cost	No fuel	1,842 kWh per ton of Coal (Energy information administration US)
Reserves-to-Production ratio (R/P)	Life time	113 years (BP, 2013)
Operating Cost (USD/kW)	10.95 Onshore 14.28 Offshore (Source Open Energy Information)	27.50 (pulverized, scrubbed) 38.67 (integrated gasification combined cycle) (Open Energy Information)

The utilization of coal at such a large scale is not a rationale decision. The coal will be used for power generation as a substitute hand by hand with the development of renewable energy. Once the targeted share of RE is achieved dependency on the coal power will be reduced.

Table No. 4.11 Assessment of Alternatives

Alternatives	SEA objectives									
	SEA O-1	SEA O-2	SEA O-3	SEA O-4	SEA O-5	SEA O-6	SEA O-7	SEA O-8	SEA O-9	SEA O-10
Option 2 Efficiency	P + D LT	P - D LT	P + I LT	?	P + D LT	P + D LT	P + D LT	P + D LT	P - D LT	?
Option 3 Competition	P - D LT	P - D LT	P - D LT	P - D LT	P - D LT	P - D LT	P - D LT	P - D LT	P - D LT	P - D LT
Option 4 Sustainability	P ++ D LT	P + D LT	P + D LT	P + D LT	P + D LT	P + D LT	P - D LT	P - D LT	P + D LT	P + D LT
Option 5 balance between efficiency, competition and sustainability	P ++ D LT	P ++ D LT	P - D LT	P ++ D LT	P ++ D LT	P + D LT	P + D LT	P ++ D LT	P + D LT	P + D LT

Table No. 4.12 key

Impact character	Symbol	Explanation
Probability	VP	Impact very likely to occur
	P	Impact likely to occur
Scale	++	Large positive impact
	+	Positive impact
	0	No impact
	-	Negative impact
	--	Large negative impact
Direct / Indirect	I	Indirect impact
	D	Direct impact
Frequency / duration	LT	Long term
	ST	Short term
Trans boundary aspect	TR	Possible trans boundary effects
Uncertainty	?	Impact uncertain

4.10 Cumulative impacts

Strategic level approaches to CI are constituted, namely by the European Directive 2001/42/EC of 25 June that states the application of criteria for determining the likelihood of significant environmental effects and requires a comprehensive and systematic approach. In its Annex I the Directive also state that Environmental Reports should include any significant environmental effects, which include cumulative and synergistic effects. Following is the tabular cumulative impacts of the alternatives against SEA topics.

Table No. 4.13 Cumulative impacts

SEA topics	Cumulative impacts
Air	The National Power Policy and National Power System Expansion 2011-2030 are considered to have native impacts on air quality. The utilization of coal will produce greenhouse gas emissions. The impact is considered certain because of the clear targets in the NPSEP. The continued use of heavy fuel oil in the short term will not contribute to improved air quality.
Soil	The transportation and disposal of wastes has negative impacts on the soil property.
Material assets	The power policy has negative impact on the renewable resources but the NPSEP has positive impacts to utilize renewable resources specially wind energy.
Cultural heritage	Impacts on cultural heritage are generally project specific. Project specific assessment will be necessary for the development of any new facilities. Indirect positive impacts on the built environment could result from reduced emissions, because of less acid rain.
Climate change	Negative impacts because of the coal utilization
Water	The construction of dams has positive impacts on the water storage and conservation
Population & Human health	Negative impacts on human health from the emission of coal power plants and coal extraction.

Biodiversity, Flora & Fauna	The main impacts on biodiversity including fauna and flora from the implementation of new projects for the provision of infrastructure. Indirect positive impacts result from reduced emissions from the power stations if certain measures are implemented.
Economy	The National Power Policy and National Power System Expansion 2011-2030 have positive impacts on the economy but in a long run.
Environmental Justice	To involve the public and affected community in decision making has a positive impact

4.11 Conclusion and Recommendations

Today Pakistan is facing shortage of 4000 to 6000MW of electricity. According to the national power policy 2013 this gap of power shortage will be overcome till 2017. The gap between supply and demand is increasing with the passage of time because of the inefficiency of the overall power sector. One of the main problem is the non-serious behavior of government towards the utilization of renewable energy. To overcome this gap many thermal power plants were in installed and some are in pipeline but this has increased cost of electricity over the last decade. There is lack of coordination between the different departments dealing with the power sector. According to the Policy for Development of Renewable Energy for Power Generation, 2006 a total of 9700MW electricity will be generated from the renewable resources including small scale hydro projects (50MW or less than 50MW) by 2030. This is a very small portion from the renewable energy resources as compare to the projected power demand 98120MW by 2030.

The projected power generation mix has both positive and negative impacts on the environment. According to the NPSEP 2011-2030 the power demand will be 98,120 MW consisting of 35.7% of hydro power, 38.1% of steam turbines using Thar coal, 10.3% of CCGT, 6.7% of nuclear, 2% of interconnections, 7.2% from gas turbines and renewable energy sources. The utilization of coal for power generation is a good option of the present but it is also obvious that coal is the dirtiest fossil fuel. Pakistan has more than

300000MW of wind power potential. Continued investigation has made renewable energy more affordable at present than 25 years ago. The cost of wind energy has dropped from 40 cents per kilowatt-hour to less than 5 cents. Wind energy is clean and sustainable. Wind turbines do not create air or water pollution like other fossil fuel power plants. The government has to utilize renewable energy resources more and more. SEA has the great potential to bring sustainability in the power sector and power sector decision making.

The national power policy 2013 has no commitment to reduce air pollution or to have a realistic objective for the utilization of renewable energy resources. Political forces are one of the main reason for non-utilization of the renewable resources. National power policies are made on interest of political parties. SEA can make the national power policies, plans and programs less vulnerable to political influences thus resulting in the energy sustainability. It is fortunate the SEA is mandatory for all the provinces except Punjab. Punjab is the biggest consumer power as well as the most populous province of Pakistan the provincial government needs to make SEA obligatory.

- The government needs to conduct SEA for power sector related policies, plans and programs.
- The National Power Policy must have a clear objective to limit and reduce emission to air.
- The National Power Policy must have an objective to utilize the renewable energy resources.
- The government needs to have a clear target of the renewable energy share in national power generation mix.
- The environmental cost must be included in the different thermal power projects.
- The government has to finish taxes and duties on import of renewable energy technologies.
- The government has to utilize the coal resources for power generation in a sustainable way.
- Affected communities and general public must be involved in the decision making process.

- The government has to make SEA mandatory.
- The shopping centers and markets should be close by 10 pm.
- The government has to create awareness regarding the energy conservation and efficiency.
- To introduce most efficient gas turbines.
- To facilitate and provide electricity to far long areas by individual small solar and wind turbines.
- Stakeholders from Public and Private Sector should be encouraged by making a plans, policies and programs at national level, for the promotion of renewable resources for power production.
- There must be a state owned power policy based on sustainability which will be free political influences.
- Renewable energy technologies manufacturing industry should be established in the country to reduce the overall cost of renewable energy resources.
- Large multipurpose dams should be constructed to meet the energy demands, water requirements for irrigation, floods adaptation and mitigation and to decrease vulnerability to the negative impacts on climate change.
- To construct energy efficient buildings and schedule public park and markets for the efficient use of electricity consumptions.
- To establish penalty and reward system for the consumers.

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