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# Nepal Proposed Power Sector Development Strategy

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## ABBREVIATIONS AND ACRONYMS

ADB	=	Asian Development Bank
CEPA	=	Consolidated Electric Power Asia
CERC	=	Central Electricity Regulatory Commission
DANIDA	=	Danish International Development Assistance
DOED	=	Department of Electricity Development
EIA	=	Environmental Impact Assessment
EMS	=	Energy Management Systems
EPC	=	Environment Protection Council
ESAP	=	Energy Sector Assistance Program
ESMAP	=	Energy Sector Management Assistance Programme
ETFC	=	Electricity Tariff Fixation Commission
GOI	=	Government of India
GTZ	=	Deutsche Gesellschaft für Technische Zusammenarbeit
GWh	=	Gigawatt Hour
HMGN	=	His Majesty's Government of Nepal
HVPN	=	Haryana Vidyut Prasaran Nigam Limited
IFC	=	International Finance Corporation
IPP	=	Independent Power Producer
ISO	=	Independent System Operator
KfW	=	Kreditanstalt für Wiederaufbau
kV	=	Kilovolt
KW	=	Kilowatt
LDC	=	Load Dispatch Center
LNG	=	Liquefied Natural Gas
MOPE	=	Ministry of Population and Environment
MOWR	=	Ministry of Water Resources
NDC	=	National Development Council
NEA	=	Nepal Electricity Authority
NGENCO	=	Nepal Hydropower Generation Company
NGO	=	Non-Governmental Organization
NPC	=	National Planning Commission
NTPC	=	National Thermal Power Corporation
O & M	=	Operation and Maintenance
PLF	=	Plant Load Factor
PPA	=	Power Purchase Agreement
R & R	=	Resettlement and Rehabilitation
RLDC	=	Regional Load Dispatch Center
RMB	=	Regional Management Board
ROR	=	Run-of-River
S & MO	=	System and Market Operator
SLDC	=	State Load Dispatch Center
T & D	=	Transmission & Distribution
TFC	=	Tariff Fixation Committee
USAID	=	United States Agency for International Development
WCD	=	World Commission on Dams
WECS	=	Water and Energy Commission Secretariat
WRC	=	Water Resources Council
WRDC	=	Water Resources Development Council

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## ***Abstract***

*A major policy objective of the Government of Nepal is to develop the nation's vast hydro power resource potential to serve the electricity needs of the people, and to generate export revenue. While over the past years progress has been made in developing regulations and policies to attract investments for hydropower development, institutional constraints pose a challenge to implementation. This report attempts to analyze the key implementation constraints facing Nepal's hydropower development, and proposes options for reform. The rationale for reform is embedded in the realization that the investment needs of the power sector are growing much faster than the financing capacity of the Government of Nepal, at a time when the availability of concessional multi- and bilateral resources for infrastructure investments is declining.*

*The report notes that among the key constraints the four most prominent ones include: (i) overlaps in the policy, regulatory, and operational functions of public institutions operating in the electricity sector; (ii) inadequacies of the existing institutional structure of the National Electricity Authority to meet future needs of the power sector; (iii) insufficient institutional arrangements for the promotion of power trade; and (iv) weak institutional support for improving electricity access to rural areas. The report makes the following recommendations in the four areas listed.*

- The role of policy making should rest with the Ministry of Water Resources, with the possibility of the Department of Electricity Development and the Water and Energy Commission Secretariat given the role of executing bodies. The Electricity Tariff Fixation Committee should be redefined and over time be allowed to evolve into an independent regulatory authority.*
- While there are alternative institutional restructuring options for the National Electricity Authority, certain common principles apply for private capital to be successfully mobilized. These include: eliminating conflicts of interest; improving creditworthiness; improving opportunities for attracting private capital; and providing appropriate regulatory framework for the operation of the system and technical and commercial rules for grid operation. Reconstitution of the board of directors of National Electricity Authority with a private professional board could be a useful transition arrangement.*
- Nepal's comparative advantage in hydropower lies not as much in the cost of developing hydro projects as it does in the fact that it is unencumbered by the complex Centre-State relationships, and inter-state water disputes that characterize the Indian situation. The Government of Nepal has an opportunity to create a policy environment for independent power producers that is more favorable than in India for the development of medium sized dedicated export projects by the private sector.*
- To improve electricity access to rural areas, Nepal must supplement existing institutional methods of delivering electricity services to rural areas with innovative approaches, such as by developing community based systems. Rural electrification business must be financially viable for it to succeed. Efforts are needed to establish rules that allow cost recovery and possible mechanisms for providing subsidies for capital costs of new connections.*



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The updated version of the report was extensively discussed by a team of Bank staff including the Sector Director South Asia Energy Unit, Operations Advisor, and the Task Leader with HMGN, international donor and the NGO community in Katmandu over the period December 4 – 8, 2000. The HMGN accepted the report with minor corrections, which are incorporated in this Final version.

## **Executive Summary**

### **Introduction**

1. Despite having an estimated hydropower generating potential of about 43,000 megawatts (MW), Nepal's current total installed generating capacity is only about 319 MW (in 1999),<sup>1</sup> and its per-capita electricity consumption of about 42 kWh is amongst the lowest in the world. Only about 15 percent of the population have access to electricity. In rural areas where the bulk of the population resides (88 percent), access is even lower (5 percent), partly as a result of a higher priority given to providing power to high-density urban areas. The quality of supply is poor; systems losses are high; power shortages are persistent; and outages are frequent. Power trade with neighboring India is minimal, and Nepal has been a net importer of power from India over the past few years. Cost of electricity in Nepal is one of the highest in South Asia and has now reached the limits of affordability for a vast majority of the population.
2. Recognizing the need to address these issues and to develop its water resource potential, HMGN has made the development of Nepal's hydro-electric potential to serve the energy needs of its people and for export, one of its key developmental objectives. This objective is articulated in the Ninth Five-Year Plan document (1997-2002), and in the Water Resources Development Strategy paper. The emphasis on power development follows the adoption of the Hydropower Development Policy in the early 1990s which, combined with changes in electricity legislation and the opening up of the power sector to local and foreign private investments, was intended to make institutions operating in the power sector efficient and creditworthy, as well as increase the participation of the private sector. While under this policy and regulatory framework HMGN has been able to attract some private (foreign) investments in power generation, NEA is still neither sufficiently efficient nor creditworthy; and the trade-offs between water and power use have only recently been considered as part of the comprehensive Water Resources Strategy. Experience over the last few years has shown a lack of transparency in project planning and selection; absence of competition; growing conflicts of interest between private entities involved in the sector and NEA (which is a buyer and a joint-venture partner in NEA power generation projects); and increasing frustration about the inability to mobilize further private and public capital to exploit Nepal's water resources potential.
3. In order to address the fundamental issues facing power development, particularly in light of efforts to attract foreign investment, HMGN is in the process of developing a Hydropower Development Policy, the most recent draft of which was circulated in December 2000. While the hydropower policy is still evolving, the latest version highlights a number of significant changes. The new policy: advocates a new institutional structure, more clearly separating regulatory and promotional functions; provides greater clarity in the commitment of HMGN to general institutional reform, including unbundling and private investment in distribution; gives a more detailed enumeration of the royalty structure; provides a more detailed exposition of the rules for repatriation of equity returns for projects involving foreign investors; and gives more explicit consideration to the role of hydropower in rural electrification.
4. However, in some critical areas the proposed new policy is either unclear or does not go far enough. For example, while the policy advocates transparency in the award of licenses, it does not enumerate the criteria upon which the license would be awarded. Furthermore, the policy is unclear about the milestones which a developer is expected to have achieved before a production license is awarded (such as a signed and bankable power purchase agreement, financial closure). Nonetheless, the issuance of a new policy is appropriate and timely; and while implementation of the recommendations pose serious challenges, the policy is a significant step forward in addressing some of the issues facing power

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1. Installed capacity is estimated to have reached 378 MW in 2000, because of the coming on stream of Kimti Kola and Modi Kola during the second half of 2000 (Source: NEA's- Corporate Development Plan, FY2000/01-FY2004/05, December 2000)

development in Nepal. However, Nepal's ability to develop hydro power projects for export depend also on developments in the Indian electricity market over which Nepal has no control.

### **The Challenges**

5. Although precise estimates are difficult to make, taking into account even the conservative estimates for projected growth in demand for electricity, the financial resources required for the expansion of the power sector for domestic market alone over the next ten years are estimated at roughly US\$1.8 billion. This vastly exceeds the availability of funding from the traditional multilateral and bilateral agencies. (Adding financing requirements for export oriented projects, the capital needs are even higher). Over the period 1991-98, NEA's capital expenditures totaled around US\$730 million, of which roughly US\$490 million was raised from loans and US\$180 million in equity. Even if NEA manages to generate 25 percent of the sector's expected capital needs for the next ten years through internal cash generation, the balance of about US\$1.3 billion will have to come from external sources in the form of loans or additional equity just to satisfy the needs of the domestic market.

6. The need for raising financing has now become even more important given the declining trend in the availability of concessional official resources for power sector development, and the recognition that scarce public resources are needed for the development of social sectors. Increasingly, therefore, investment resources for power development will need to be mobilized through the private sector. Even a public sector enterprise such as NEA will have to rely increasingly on internal resources and private capital markets, which requires NEA to be creditworthy. However, the policy to attract private investments should be based on market realities. Over the past few months, in an effort to increase direct foreign investments in power, the Government has invited private investors to develop selected hydro projects in Nepal. While this step has attracted private interest and several survey licenses are under consideration, it is not clear if this initiative is sustainable, especially in light of the difficulties hydro projects face in reaching financial closure. Factors such as financing terms (and their implications for tariffs), the creditworthiness of buyers, cost of alternatives and environmental impacts, must play an important role in deciding the location of sites, and the number and magnitude of contracts to be awarded for new power projects. Furthermore, given that clients in the Indian states at present are not creditworthy, lenders are likely to seek government guarantees, potentially creating contingent liabilities for the Government. A call on these guarantees could create major macro economic disruptions. Even if none of the projects reach financial closure, the effective 'property rights' gained by private developers to good hydro sites could prevent their development for an extended period of time. The long process of renegotiations without adequately addressing the fundamental policy and structural problems, run the danger of damaging private sector confidence in Nepal.

7. Thus, the primary challenge facing Nepal is to generate sufficient financial resources to expand its power supplies—based on market realities—in an environmentally sustainable and socially acceptable way to meet the needs of its people both in the rural and urban areas. Additionally, power supply expansion needs to be done in a least-cost way that makes power affordable to domestic users and allows Nepal exports to maintain a position of comparative cost advantage. The strategy to expand power supplies and access to these supplies by the majority of consumers is inevitably linked with the paramount goal of poverty reduction.

### **The Strategy for the Future**

8. While over the past years, progress has been made in developing regulations and policies to meet HMGN's developmental objectives for the power sector, further institutional changes are required to ensure their implementation. There are several areas where HMGN action is needed, the most important among them include: clarifying the roles and responsibilities of public sector institutions operating in the power sector; restructuring and privatizing NEA; promoting power trade with India; and improving rural access to electricity. These are briefly discussed below.



9. ***Clarifying the Roles and Responsibilities of Public-Sector Institutions:*** Under the current institutional framework, there is no clear separation of policy, regulatory, and operational functions in the electricity sector. Furthermore, coordinating bodies designed to ensure consistent policy making between sectors are not functioning adequately. Collectively, there are about 14 institutions which, in combination with a multi-level approach, have led to conflicting roles and responsibilities. There are multiple institutions involved in policy formulation. The extent of overlap between the five main entities active in power, viz., Ministry of Water Resources, NEA, Electricity Development Center, (recently the name of this agency has been changed to the Department for Electricity Development), Water and Energy Commission and Electricity Tariff Fixation Committee, is evident from the fact that all five entities are involved in several similar activities such as systems planning; project identification; issuance of survey license; and multipurpose and export oriented projects. (Chart 1)<sup>2</sup>. These overlapping roles of public sector entities, and the resulting conflict of interests, have been sending confusing signals to the private sector and have constrained their involvement in Nepal's power development.

**Chart 1: Overlapping Roles of Power Sector Institutions**

Overlapping Role	MOWR	NEA	DOED	WECS	ETFC
Hydropower Development	✓	✓		✓	
Project Identification		✓	✓	✓	
Project Selection		✓	✓		
Survey License	✓		✓		
Production License	✓		✓		
Competitive Bidding	✓		✓		
Tariff Setting		✓			✓
Private Power Projects	✓	✓	✓		
Multipurpose & Export Projects	✓		✓	✓	

10. Many of these issues have been highlighted in the last few years, but rather than clarifying the role of existing entities or modifying existing policies and guidelines, the reaction has been to create new umbrella organizations or coordinating committees thereby compounding the problem. Clearly there is an urgent need for seeking a consensus among the agencies on their respective roles in sector development; planning, licensing and regulatory regimes; and water resource development for multipurpose and export projects. This would facilitate private sector investment in the power sector. Rationalization of government agency roles and responsibilities is also a fundamental requirement to meet the Government's objectives of developing a new industry structure.

11. The following actions should be considered as soon as possible: (i) consolidate technical policy advice on water resources development into one entity and eliminate overlapping responsibilities within the Ministry of Water Resources; (ii) clarify responsibilities for monitoring and enforcing compliance with environmental legislation between the Ministry of Population and Environment and the Ministry of Water Resources; (iii) rationalize planning functions; (iv) finalize the comprehensive review of the Department for Electricity Development (Electricity Development Center) licensing procedures and regulatory function of the Electricity Tariff Fixation Committee, and consider the establishment of a

2. In few areas however, the functional role of institutions such as WECS is limited. For example, the role of WECS in project identification is limited only to inventory studies; and to the identification of small private hydro power projects. MOWR sets the policy, and DOED is the executing body.

separate regulatory authority; (v) prioritize agreed institutional and policy changes and start implementation; (vi) accelerate creation of the Power Development Fund and initiate competitive bidding process for medium size hydropower projects; and (vii) finalize the preparation of the national water resource strategy and create national consensus on basin development.

12. ***Restructuring and Privatizing NEA:*** Though in the South Asian regional context NEA, as an integrated utility, has been performing better than many other publicly owned utilities, serious problems still persist: its operational efficiency is weak (transmission and distribution losses of the NEA system [technical and non-technical] are around 30 percent and in some areas are as high as 50 percent); its creditworthiness is insufficient to allow access to private capital markets; and there are growing conflicts of interest with existing and new independent power producers, some of which are joint ventures between private investors and NEA, and for which NEA is also the principal buyer. Furthermore, NEA, as the owner of the transmission and load dispatch system, has conflicts of interest with regard to opening-up grid access to private independent power producers, since NEA decides what independent power producers can and must do. There are examples around the world of integrated utilities operating at reasonable levels of efficiency; however, there are very few examples in developing countries demonstrating that integrated publicly owned utilities develop into efficiently operated entities with adequate access to private capital markets, and at the same time, resolve the conflict of interest issue, combined with a significant entry of private power producers in the market. Moreover, there is growing experience that an unbundled power supply system with significant private ownership in distribution, if appropriately regulated, would be able to provide over time much better service delivery at much lower cost. Therefore, developing NEA as an integrated publicly owned utility cannot be considered as an optimal solution. The need for restructuring NEA is clear, and the rationale for restructuring is grounded in the needs of the future, *inter alia*, mobilizing private capital necessary for the much larger future facilities contemplated by NEA's generation expansion plan (such as Upper Karnali and Arun).

13. Worldwide experience shows that there is no one formula that can be held up as a universal model. Each country has unique problems, resources, and institutions. There are several possible restructuring options NEA can adopt, some of which include:

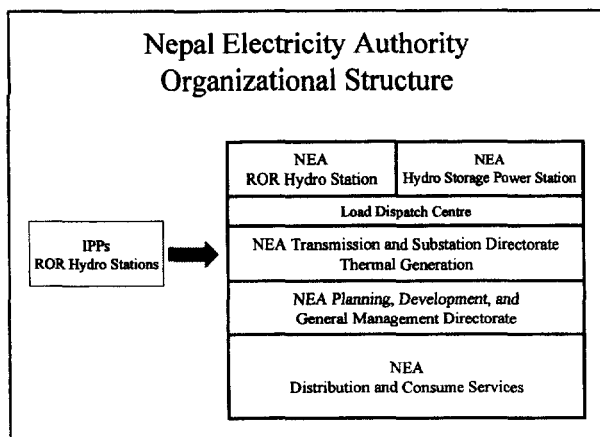
- internal reforms (in which NEA's functions are internally separated through creation of profit centres);
- spinning off NEA's joint venture as separate companies;
- unbundling generation, transmission, and distribution (along the lines of many countries in Latin America and India (Orissa and Andhra Pradesh), sometimes referred to as a single buyer or Independent Market Operator (IMO) model);
- subsequent privatization of unbundled entities – again there are several options, ranging from outright sale to strategic investors, to joint ventures with minority Government participation (or with so-called “golden shares,” an approach used in privatization of some public companies in the United Kingdom) and listing on the stock exchanges;
- management contracts (although the South Asian experience has not been very successful, the results have been more positive in Africa and Latin America).

14. In more developed countries, the IMO model often evolves into a competitive Wholesale Market Model with competition introduced even at the retail level. For Nepal, the Wholesale Market Model could only become a realistic option in the distant future, once several new players have entered the market and creditworthiness is fully restored, implying several years of successful operation of unbundled distribution companies under the IMO model. Privatization of distribution and transparency in systems operating rules are key elements of the IMO model.

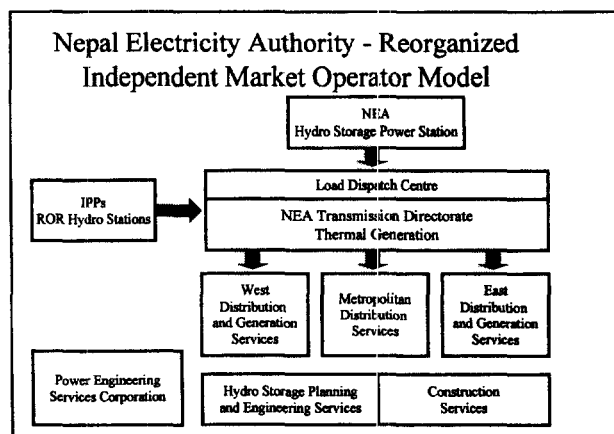
15. While there are several approaches to unbundle Nepal's power system, a possible option would be to differentiate entities by functions and responsibilities as follows: NEA would be reorganized into two

Integrated Generation and Distribution Companies (IGDs); one Distribution Company; one Generation Company; and one Transmission Company with the load dispatch center. Other variants are possible while maintaining the same principles and objectives and would need further study. The existing and alternative industry structure characterized as variants of the IMO Model are illustrated in Charts 2A & 2B below. An important feature of this variant of the IMO model is that it permits distribution companies to have generation (integrated-generation companies), and these companies can trade excess energy with other generators and distributors. It therefore does not involve a complete separation of the system into generation, transmission, and distribution companies, as typically implied by unbundling. The model and its suitability for Nepal are discussed in more detail in the background report.<sup>3</sup>

**Chart 2A: Existing NEA Structure**



**Chart 2B: IMO Model**



16. Whatever model of institutional reform is followed, there are certain principles that apply everywhere for private capital to be successfully mobilized, such as: eliminating conflicts of interest and leveling the playing field for private investors; an adequate regulatory system, and transparent systems operating rules. Reconstitution of the board of directors of NEA with a private professional board could be a useful transition arrangement, but unbundling without a significant shift towards private ownership is unlikely to achieve the desired efficiency gains and increase the access to private capital. However, before deciding on an exact configuration of the unbundled power sector most appropriate for Nepal, preparatory studies are required which would include, *inter alia*, definition of technical boundaries, allocation of assets, liabilities and personnel, transfer pricing, dispatch and system operating rules, wheeling arrangements etc. Options for phasing the unbundling by, for example, creating companies similar to the Butwal Power Company could be considered.

17. **Promoting Power Trade with India:** The potential market for power in India, particularly the Northern Grid Region—including Western Uttar Pradesh, and Delhi, which lies to Nepal's west—is large. The Indian Central Electricity Authority (CEA) has estimated a shortage of roughly 10,000 MW in the Northern Region at the end of the Tenth Five-Year Plan (2007). This region faces chronic power shortages that are likely to continue in the foreseeable future and could considerably benefit from power exports from Nepal. While the potential for exports is large, the very conditions that have led to the presently large shortages of power in India, namely the effectively bankrupt and commercially uncreditworthy financial condition of many Indian State Electricity Boards (SEBs), also constrain any large-scale absorption of Nepalese exports. Progress in Electricity Board reform in Orissa, Haryana and

3. Institutional restructuring of NEA, Mangesh Hoskote and Bearice Arizu, April 2000.

Andhra Pradesh, as well as in Uttar Pradesh, Rajasthan and Karnataka which are on the verge of reform, combined with several positive developments recently in India, would enhance the opportunities for Nepalese hydropower exports. These developments include the establishment of the Central Electricity Regulatory Commission; the creation of the Power Trading Corporation (PTC); the regional load dispatch centers operated by Powergrid; and the increasing integration of the regional grids through additional inter-tie capacity. However, these developments will also benefit Indian hydro schemes that are potential competitors to Nepalese export projects. Nonetheless, a healthy and financially viable Indian power sector would also benefit Nepal. The recent developments in India mentioned above improve the prospects for developing power pool trading arrangement into which Nepal could sell its output. Such pools may either be on a gross – where all power is sold through the pool—or net basis, where only power not already sold under physical bilateral contracts is traded. Successful pools however require, *inter alia*, mature and robust commercial environment and competitive electricity markets, under which individual generators compete for the dispatch of their plant outputs on a daily or hourly basis, a situation which is not likely to happen in South Asia for quite sometime in the future.

18. Nepal's comparative advantage in hydropower lies not in the cost of developing hydro projects, but mainly in its ability to create an institutional framework that would enable export oriented hydro projects to be implemented more easily than in India, and less subject to delays due to inter-state water disputes and resettlement and rehabilitation controversies. Although the Arun precedent, and the existence of some 30,000 NGOs suggest that developing hydro projects in Nepal will face some difficulties, the fact that Nepal is a small country unencumbered by the complex Centre-State relationships that characterize the Indian polity, gives HMGN some advantages vis-à-vis India. These advantages can be maximized by creating a policy environment for independent power producers that is more favorable than in India. While important steps in this direction have already been taken, additional action is required to strengthen Nepal's potential advantage over India.

19. Large projects would benefit from economies of scale and lower costs. However, given the lack of creditworthy clients in India for the next several years, the rehabilitation and resettlement problems associated with larger projects, and the inherent difficulty with raising financing for large hydro projects, the best prospects for increasing hydro exports over the medium term are smaller, dedicated medium sized export projects whose output can be absorbed by creditworthy buyers. Such projects would still be difficult to implement since even under ideal conditions, hydro projects are more difficult to implement as independent power producers than thermal projects, but their prospects are materially better than for mega-hydroprojects. Focusing on medium and smaller dedicated export projects does not mean, however, that efforts to continue with the development of large storage hydro and multi-purpose projects should be abandoned completely. An important first step should be to explore new models of public-private partnerships to address the difficulties of attracting private financing for large projects. These options would require institutional reforms in the Nepal power sector and at a minimum separate hydro-generation company mandated to run on commercial lines. This company could initially be Government owned but established in a suitable form for raising private capital through joint ventures and/or special purpose project companies.

20. In order to implement this hydropower export strategy, HMGN should consider taking several immediate actions as follows:

- seek ratification of the Power Trade Agreement between India and Nepal which is still before Nepal's Parliament, and institute regular meetings of the Power Exchange Committee;
- update the Masterplan to reflect recent developments in India;
- study new market arrangements in India, and the market prospects for Nepalese power output in South Asia;
- explore possibilities for sale of surplus energy during wet seasons to the Northern Indian grid;

- conduct a detailed engineering study to quantify the costs, benefits, and optimal timing of asynchronous links and grid integration with India; and
- identify daily peaking run-of-river sites in the medium size range for potential private sector development as dedicated export projects.

21. ***Improving Rural Access to Electricity:*** Low access to electricity in Nepal has deprived the people of basic amenities of life and of opportunities for development. The lack of access to commercial energy forces rural consumers (comprising over 88 percent of the population in Nepal in 1996) to rely on traditional fuels, mainly fuelwood, agriculture waste, and animal dung for cooking and lighting needs. Of the total residential energy consumption in rural areas, traditional fuels in 1995/96 accounted for over 98 percent of consumption (in urban areas the share of traditional fuels was just under 77 percent). The heavy reliance on traditional fuels poses serious threats to the health of the rural population, especially women and children who are most exposed to indoor pollution.

22. There is sufficient evidence on the positive impact access to electricity has on the lives of the poor. Studies in other countries show that having electricity is beneficial for children's education because it facilitates reading during the evening and in the early morning hours. Electricity also provides access to knowledge and information to people in rural areas via communication media such as television and radio that otherwise would not be possible. Depending on the conditions in local communities, electricity can also lead to increases in rural productivity by allowing work in the evening hours. Electricity programs often complement health programs by providing refrigeration for medical supplies. Evidence from Peru shows that programs involving complementary social infrastructure, including rural electrification, have a greater impact than any one type of infrastructure on its own.

23. The main challenge therefore, is to provide sustainable and affordable access to energy in the rural areas. The importance of meeting this challenge is articulated in the Ninth Plan, which documents HMGN's desire to improve the provision of electricity services to rural areas. While the provision of a full range of energy services (including access to petroleum products, together with improved cooking stoves with a chimney) should constitute the nation's rural energy policy, the focus of discussions here is on rural electrification only.

24. There is no single technology that would best suit all possible applications and rural settings, and only a mix of different rural energy technologies can respond to the diverse site conditions and customer requirements. The optimal choice of rural energy technology varies depending on factors such as: site and location; distance between the rural load centre and the integrated Nepal power system (INPS); access to road; whether or not the electrification project is a greenfield development, and how much experience the rural community has with electrification projects; expectations about future industrial loads, lighting and entertainment needs; and harmony within the communities etc.

25. While the expansion of the national grid is an important rural electrification option, because of the difficult terrain and the low level of general electrification in Nepal this option alone will not solve the problem. In addition, the grid expansion would require an adherence to the principles of emerging best practices, including financial viability of the national entity, NEA, involved in developing rural distribution systems. At present, except for initiatives such as those by the Butwal Power Company (BPT), grid-based rural electrification is the sole responsibility of NEA. The BPT is the only other non-NEA agency that has so far implemented grid-connected rural electrification, with relatively better success than NEA. It is not clear whether NEA is the most suitable agency to promote rural access. This is one area which warrants the active participation of the private, as well as the public sector. Other options for increasing electrification in rural areas include:

- mini grids based on micro, small and medium hydro
- mini grids based on diesel and photo voltaics

- battery charging stations connected to the grid or any of the above mini grids
- solar home systems
- wind
- biomass

Several international donor agencies are actively involved in a number of decentralized rural electrification schemes but the impact so far has been small.

26. Subsidies are clearly undesirable because of the many distortions they can create; their regressive nature; and the difficulties in removing them once their usefulness is outlived. Furthermore, there is ample evidence world wide that subsidies rarely reach the poor for whom they are intended. However, subsidies may be needed to promote rural electrification in Nepal as evidenced by examples from other countries.

27. In designing a subsidy scheme the following important questions must be carefully considered: *whom to subsidize?* If subsidies are meant to improve the welfare of the poor, they must be directed to the people who cannot afford access to high-quality energy services. These are typically the very poor, living in rural areas. *What to subsidize?* Evidence from other countries show that providing a partial subsidy on the cost of connections is more effective than a subsidy for ongoing energy charges. Capital subsidies on access costs not only reduce the cost of service to the poor; it also encourages businesses to increase connections in the rural areas. *How to subsidize?* Subsidy implementation mechanisms are broadly categorized as demand side subsidies and supply side subsidies. Although, in the context of Nepal further study is needed to establish the right mechanism, in general, demand side subsidies that involve partial funding of connections, work better. Demand side subsidies have better targeting properties and provide greater incentives for expanding coverage and sustaining services. Supply side subsidies, although easier to implement, have the disadvantages that they are difficult to target, and often undermine efficient service delivery, and raise costs above what they would otherwise be. While the proper design of the subsidy would improve its effectiveness in reaching the poor, the ultimate success of the subsidy schemes also requires setting up effective institutional structures, developing regulations that allow businesses to charge remunerative prices for energy services they provide, mechanisms to offset the tendency of politicians to divert subsidies to political interest groups, and the active involvement of community groups in the design of subsidies.

28. To promote rural electrification, the following actions are needed: (a) develop community based micro-hydro systems; (b) commercialize the pico-hydro systems to replace and supplement the traditional water power systems; (c) establish and strengthen user groups; (d) launch awareness campaigns about the possible productive uses of electricity and the markets for the products produced; (e) assess barriers to private entry in rural electrification projects; and (f) create an enabling environment that promotes private sector involvement. Possible institutional means to achieve the above action plan could include the following: (i) setting-up a Rural Electrification Office with the capacity for providing technical assistance support for the development of grid and non-grid electrification projects; (ii) establishing rules for off-grid rural electrification including for possible subsidy schemes and for ensuring that the private sector can charge tariffs that allow them to operate a financially sustainable business; (iii) assessing the desirability of well targeted and conceived loan funds, with possible subsidies for capital costs for new connections; (iv) developing low cost off-grid extensions; and (v) coordinating donor support to maximize efforts to achieve rural electrification, especially off-grid electrification.

## I. Introduction

1. Despite having an estimated hydropower generating potential of about 43,000 MW,<sup>4</sup> Nepal's current total installed generating capacity is only about 319 MW,<sup>5</sup> and its per-capita electricity consumption of about 42 kWh is amongst the lowest in the world. Only about 15 percent of the population have access to electricity. In rural areas where the bulk of the population resides, access is even lower (5 percent), partly as a result of a higher priority given to providing power to high-density urban areas. The quality of supply is poor; dry season generation capacity is inadequate; systems losses are high; and outages are frequent. Power trade with neighboring India is minimal, and Nepal has been a net importer of power from India over the past few years. Despite the desire for reform expressed by His Majesty's Government of Nepal (HMGN) and the initial measures being implemented, serious problems persist which impede HMGN's ability to respond to the sectors developmental objectives.

2. In this discussion paper we examine some of the key problems facing the development of Nepal's power sector, and propose options to address these problems. We ask *why* these main problems have arisen and to what extent they could be mitigated by reform. For example, there is not much that can be done about Nepal's geography and lack of indigenous fossil resources, which makes the cost of imported liquid fuel for thermal generation relatively expensive. But there is much that could be done to ensure that:

- Nepal's hydro resources meet the needs of its urban and rural population in a least-cost way.
- The roles of various public sector institutions are clear and non-conflicting.
- There are in place regulatory and institutional frameworks that make it easier to mobilize private capital.
- Power is not made even more expensive to the consumer due to high T&D losses characteristic of an inefficient institutional setup.
- The structure of the main public-sector institution (NEA) operating in the power sector is such that it is creditworthy and enables, rather than prohibits, the realization of the long-term developmental goals of the sector in partnership with the private sector.
- The expectations about the prospects for export and revenue realization are realistic, and efforts are made to realize these expectations.

This paper reviews options in four critical areas that are at the core of Nepal's power sector problems, *viz.*, the roles and responsibilities of public-sector institutions in the energy sector; institutional structure of NEA; power trade with India; and rural access to electricity.

3. The paper does not claim to have answers to all of Nepal's power sector problems. It recognizes that results cannot be achieved overnight and many changes require long gestation periods and need to be implemented in the near term to be most effective, especially in areas that demand major capital investments. As the problems of the sector deepen, sector reform becomes increasingly difficult, underscoring the need to act without delay. The paper also recognizes that sustainable solutions come about only if the stakeholders themselves take ownership of the work. It is evident that on many issues it will take time to find the degree of consensus necessary to allow a finalization of the power sector development strategy, particularly given the on-going formulation of the water development strategy and the proposed revisions to the Hydropower Development Policy which now seems to be on the fast track. The new Hydropower Development Policy provides clear signals on the direction of power reform HMGN's wishes to take. The recommendations provided in the latest version (December 2000) of the Hydropolicy are consistent with the findings and recommendations of this report *viz.*, Power Sector

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4. The Nation's hydropower production capacity is estimated to be roughly 83,000 MW. Of which about 43,000 MW is considered economically and technically viable.

5. Installed capacity is estimated to have reached 378 MW in 2000, because of the coming on stream of Kimti Kola and Modi Kola during the second half in 2000 (Source: NEA's Corporate Development Plan, FY2000/01-FY2004/05, December 2000).

Development Strategy (PSDS). Detailed comments on a previous version of the Hydropower Development Policy (June 2000) are recorded in Annex 1.

4. The objective of this paper, together with the three detailed background reports viz.: 1) Institutional Restructuring of NEA, Mangesh Hoskote and Beatrice Arizu, April 2000; 2) Hydropower Exports from Nepal, prepared for The World Bank by Peter Meir, April 2000; and 3) Nepal: Power Sector Development Strategy, Rural Electrification Component, prepared for The World Bank by ENTEC AG, October 26, 1999 is to enumerate the main options; assess the advantages and disadvantages of each (bringing to bear the lessons of the relevant worldwide experience); and suggest a program of action in each area. Many of the proposed actions are required regardless of the final restructuring model chosen by HMGN: For example, across a very wide range of options for restructuring and ownership of NEA, its generation function needs to be placed in a separate entity. In preparing this report, we have taken into account comments made in the Technical Discussion meeting held in Katmandu on February 27-28, 2000 and a series of workshops held in Kathmandu over the period December 4-8, 2000. The Technical Discussions meeting and the workshops were attended by senior policy makers and a number of other key stakeholders. It is anticipated that the findings of this report will assist HMGN to formulate its own strategy for the development of the power sector.

## **II. Overview of Nepal's Power Sector**

### ***Supplies and Resource Base***

5. Nepal has vast hydro resources, which represent a source of potential wealth. Commercially exploitable hydropower generating potential is estimated to be about 43,000 MW. Except for some lignite deposits, Nepal has no known oil, gas or coal deposits. All commercial fossil fuels (mainly oil and coal) are either imported from India or from international markets routed through India. Fuel imports absorb over one-fourth of Nepal's foreign exchange earnings.

6. Despite the hydro potential, hydro electricity accounts for only one percent of total energy supplies. The bulk of Nepal's energy supplies (about 91 percent) comes from traditional sources, mainly from fuelwood (68 percent), agriculture waste (15 percent), and dung production by livestock (8 percent). Commercial sources, including hydro, account for the remaining nine percent (petroleum 7 percent, coal 1 percent, and hydro electricity 1 percent).

7. Nepal's domestic electricity supply system is small. Current total installed electric power generating capacity is dominated by hydropower, which constitutes 84 percent of installed capacity.<sup>6</sup> The balance is composed of thermal installations using multifuels and diesel plants.

8. Hydropower facilities are mostly run-of-river, accounting for 71 percent of installed capacity. A system dominated by run-of-river is susceptible to high rates of spillage. Although firm estimates are not available, in some years about one-fourth of hydro production was lost due to spillage. While more storage plants could indeed reduce spillage, storage projects are usually relatively more expensive. Run-of-river (albeit with sufficient pondage to be used for daily peaking) represent the least-cost development plan of the NEA system, at-least until such time as the Nepalese system is interconnected with India. Currently, only one power station--the 92 MW Kulekhani--has seasonal storage capacity. The main load center is the central zone, which includes the Kathmandu Valley. The main transmission line is 132

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6. With the addition of two new hydropower generating facilities during the second half of 2000, share of hydro has now jumped to an estimated over 86 percent.



kilovolts (kV) and runs for approximately 1200 kilometers parallel to the Indian border from east of Nepal (Anarmani) to west of Nepal (Mahendranagar); major sub-stations are located in Hetuda, Syuchatar and Balaju.

### ***Demand and Prices***

9. The main consumers of electricity are households and industries, accounting for 39 percent and 42 percent, respectively, of total power use in 1999. Although the growth rate in the demand for power in industries has outpaced that of households over the past decade, these two sectors account for roughly 82 percent of total electricity demand. Commercial (7 percent), non-commercial (6 percent), water supply and irrigation (2 percent) and lighting (3 percent) account for the remaining 18 percent (Table 1, Chart 3). Electricity use is characterized by a load profile dominated by a large number of household connections and relatively few industry consumers. In 1998, the domestic sector accounted for 95 percent of customers while the industrial, and combined commercial and non-commercial consumers accounted for less than 2.5 percent and 1.8 percent, respectively. A high proportion of domestic load exhibits strong evening lighting load peaks and little baseload industrial load that could absorb off-peak run of river energy.

**Table 1: Electricity Sales by Consumer Category in Gigawatt Hour  
(1991-1999)**

Category	1991	1992	1993	1994	1995	1996	1997	1998*	1999**
Domestic	261.39	275.24	259.83	275.05	301.61	328.73	355.11	378.77	415.24
Non-Commercial	46.23	46.68	47.60	47.14	53.22	53.46	57.99	60.22	64.49
Commercial	36.64	45.20	47.60	48.98	58.57	62.91	67.60	71.47	77.78
Industrial	206.88	246.37	273.75	303.99	328.31	358.67	376.74	413.73	437.14
Water Supply & Irrigation	27.68	27.70	24.11	19.40	27.63	25.09	27.97	29.04	23.44
Street Light	7.30	7.80	8.06	8.85	12.17	16.72	20.92	26.58	29.72
Temporary Supply	0.42	1.00	0.92	0.56	1.22	1.15	0.84	0.71	0.70
Transport	1.82	1.50	1.39	1.33	1.45	1.43	1.48	1.66	2.24
Temple	0.36	0.41	0.46	0.65	0.89	1.50	1.69	1.80	2.10
Total (Internal Sales)	588.76	651.94	663.24	705.99	785.10	849.68	910.38	984.01	1,052.88
Bulk Supply	80.64	85.41	46.13	50.51	39.47	87.01	100.21	67.41	60.00
<b>Grand Total <sup>a</sup></b>	<b>669.40</b>	<b>737.35</b>	<b>709.37</b>	<b>756.5</b>	<b>824.58</b>	<b>936.69</b>	<b>1,010.60</b>	<b>1,051.42</b>	<b>1,112.88</b>

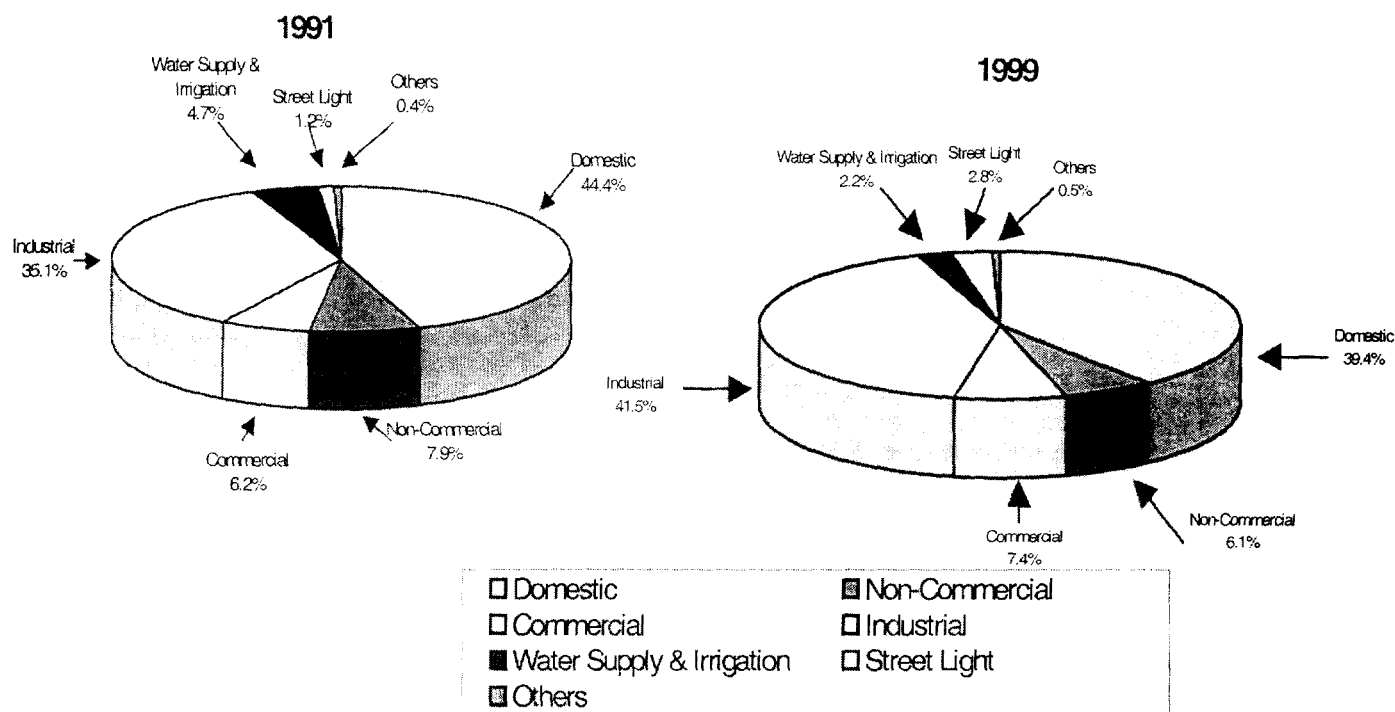
Source: National Electricity Authority – A Year in Review FY1998/99

Note: \* Subject to final audit

\*\* Provisional figures

a. In 2000, sales are estimated to have increased to 1269 Gigawatt Hour ((Source: NEA's- Corporate Development Plan, FY2000/01-FY2004/05, December 2000).

Chart 3: Electricity Demand



10. Power tariffs in Nepal, presented in nominal terms, increased steadily over the last decade (Table 2 and Chart 4). In real terms however, power tariffs have been declining since 1997, and in the first half of 1999 had slumped close to the levels prevailing in 1996 (Table 2). However, in November 1999, power tariffs rose sharply, by about 25 percent in nominal terms reaching Rs. 6.2/kWh, reversing the real decline experienced over the previous two to three years. The cost of power in Nepal is now amongst the highest in Asia (Table 3 and Chart 5). For example, the average power tariff in Nepal is more than double the average tariff in India, although part of the difference reflects large power subsidies provided to agriculture and residential consumers in India. Although agriculture users (for irrigation) pay less than other types of consumers, the fundamental pricing issue in Nepal is not as much in the tariff structure as it is related to the high cost of power which is passed on to consumers in tariffs.

**Table 2: Power Tariffs – By Consumer Category (1991-1999)**  
(Rupees/kWh – in Nominal Rupees )

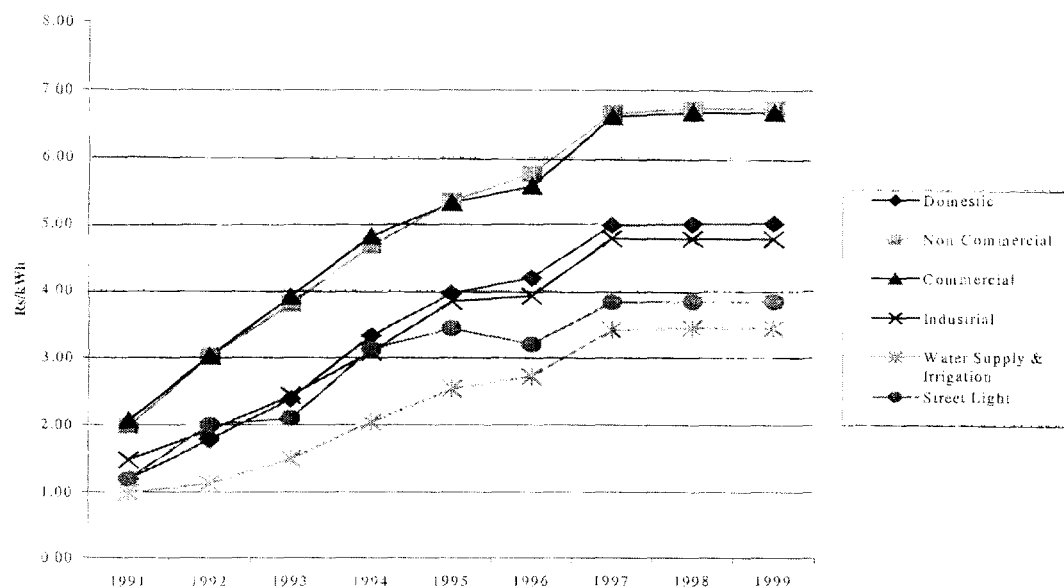
	1991	1992	1993	1994	1995	1996	1997	1998	1999
Domestic	1.19	1.78	2.39	3.33	3.96	4.19	4.98	5.00	5.01
Non-Commercial	1.98	3.02	3.80	4.66	5.34	5.75	6.66	6.73	6.73
Commercial	2.07	3.02	3.91	4.81	5.31	5.56	6.61	6.67	6.67
Industrial	1.48	1.92	2.44	3.08	3.84	3.92	4.78	4.77	4.77
Water Supply & Irrigation	0.99	1.13	1.50	2.04	2.54	2.72	3.42	3.45	3.45
Street Light	1.20	2.0	2.10	3.12	3.44	3.20	3.83	3.84	3.84
Average (Internal Sales)	1.40	1.99	2.59	3.38	4.05	4.22	5.05	5.05	5.07
Bulk Supply (India)	1.68	1.71	1.64	1.81	2.47	2.38	2.49	2.97	3.00
Average Tariff (in nominal terms) <sup>b</sup>	1.44	1.95	2.53	3.27	3.97	4.05	4.80	4.92	4.96 <sup>a</sup>
Average Tariff (in Real 1991 Rupee)	1.44	1.64	1.92	2.31	2.64	2.49	2.75	2.73	2.50
Late 1999 Tariff (in Real 1991 Rupee)									3.12

Source: National Electricity Authority – A year in Review FY1998/99

– Note: a. Average tariff up to November 1999

b. In 2000, average revenue rate (Rs/kwh) increased to an estimated 5.57 in nominal terms (Source: NEA's- Corporate Development Plan, FY2000/01-FY2004/05, December 2000).

**Chart 4: Evolution of Power Tariffs, by Consumer Category (1991-1999) <sup>1</sup>**  
(Rupees/kWh - in Normal Rupees)



<sup>1</sup> Calculated on the basis of revenue per unit sale

**Table 3: Comparison of Electricity Tariffs in Selected Asian Countries**  
(\$/kWh)

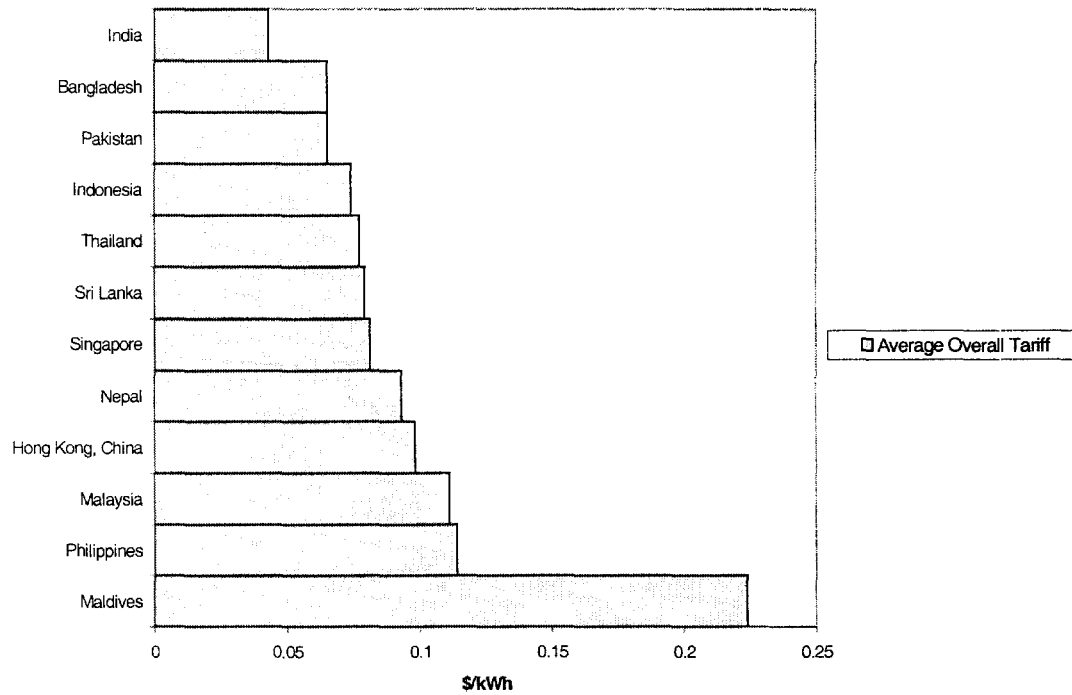
Country	Utility	Average Overall Tariff
Maldives	Maldives Electricity Board	.224
Philippines	Manila Electricity Company	.114
Malaysia	State Electricity Board	.111
Hong Kong, China		.098
Nepal <sup>1</sup>	Nepal Electricity Board	.093
Singapore	Public Utilities Board	.081
Sri Lanka	Ceylon Electricity Board	.079
Thailand	Provincial Electricity Authority	.077
Indonesia	Perusahaan Umum Listrik Negara	.074
Pakistan	Water & Power Development Authority	.065
Bangladesh	National Average	.065
India	National Average	.043

<sup>1</sup>Note: Tariffs for Nepal are for late 1999

Source: *Electric Utilities Data Book*, by Asian Development Bank, 1997

*Rural Electrification, Distribution and Transmission Project*, Asian Development Bank, November 1999

Chart 3: Comparison of Electricity Tariffs in selected Asian Countries



Source: *Electric Utilities Data Book*, by Asian Development Bank, 1997  
*Rural Electrification, Distribution and Transmission Project*, Asian Development Bank, November 1999

11. The relatively high power tariff in Nepal is attributed to, *inter alia*, the nature of its generation mix, largely hydro based (about 82 percent), which is inherently more capital intensive than thermal generation. For example, in Nepal, hydro plants have costs in the range of \$2000-\$3000/kilowatt (kW), as opposed to \$400-\$700/kW (life-cycle cost) for thermal generation based on combustion turbines (Hydro Generation costs account for a bulk of the costs, about 69 percent of the total incremental cost)<sup>7</sup>. However, a combination of other institutional, technical and economic factors also contributes to the high cost of power in Nepal, including: small size of generation units (which makes difficult the exploitation of scale economies of hydro plants); lack of interconnections; a mismatch between consumption and what is produced and high degree of spillage; and inefficiencies in NEA's system, which result in high transmission and distribution (T&D) losses (technical and non-technical losses are around 30 percent, and in some areas as high as 50 percent).

### Market Balance

12. Although power supplies have increased over the last decade, domestic supplies are unable to meet local demand. Shortages are met through load-shedding, especially during the evening peak demand periods and imports. At present, Nepal is a net importer of power from India. In 1998, purchases from India stood at roughly 210 gigawatt hour (GWh) (about 15 percent of total available energy); provisional estimates for 1999 show an increase in imports from India by about 10 percent to 232 GWh (Table 4). Although current expansion plans, consisting of seven projects due for commissioning during the period January 1999 to January 2001, are expected to virtually double the installed capacity of the system in the next three years, the peaking power shortage situation is not expected to be resolved.

**Table 4: Peak Demand and Available Energy Supplies in Nepal**  
(1991-1999)

	1991	1992	1993	1994	1995	1996	1997	1998*	1999**
Peak Demand (MW)*	204.0	216.0	214.0	231.0	244.0	275.0	300.1	317.0	326.4
Available Energy (GWh)	906.2	981.1	963.3	1,030.8	1,117.4	1,261.9	1,368.5	1,373.1	1,475.0
1. Hydro	870.2	869.9	804.0	835.4	848.7	1,072.7	1,096.6	971.9	1,046.5
2. Diesel	0.80	31.5	47.2	62.2	80.9	36.6	39.7	107.4	118.8
3. Purchase from	35.2	79.5	111.9	133.2	187.8	153.5	232.2	293.7	309.6
(a) India	33.7	54.9	82.2	102.7	113.8	72.9	153.9	210.2	232.3
(b) Butwal Power Co.	1.5	24.6	29.7	30.4	73.9	80.6	78.2	83.4	77.2

Source: National Electricity Authority – A year in Review FY1998/99

Note: Peak demand is for all areas covered by integrated system including supply to India.

\* Subject to final audit

\*\* Provisional figures

13. A recent NEA report shows that the coming on stream of new projects presently under construction, particularly Kali Gandaki-A (144 MW) in 2001-02, will generate a short-term power surplus; however, based on the expected growth in demand, the power deficit will begin to reemerge in 2003-04 and worsen beyond that unless yet further new capacity is added. NEA's most recent forecasts for the period 1999 to 2017 project energy requirements will increase from 1475 GWh to 5937 GWh. Peak demand is projected to grow from an estimated 326 MW in 1999 to 1355 MW in 2017.

7. The cost comparisons are provided for illustration purposes. Thermal plants have higher operational costs and carry significant fuel price risks, factors which under certain circumstances could make hydro less expensive than thermal generation.

### III. Main Issues and Challenges

14. HMGN has made the development of Nepal's hydroelectric potential, to serve the energy needs of its people, one of its key developmental objectives. This objective is articulated in the Ninth Five-Year Plan Document (1997-2002) and in the Water Resources Development Strategy paper. The Ninth Plan seeks to:

- Produce sufficient hydro-electricity at cheaper cost and meet the demand for agriculture, industry, transport, domestic, commercial and miscellaneous sectors at an affordable price, and export it at a competitive price.
- Link up rural electrification with rural economic activities and support the growth of the rural economy.
- Reduce rural-urban disparity in electricity supply as well as maintain a regional balance.
- Pay special attention to the environmental aspects of hydro-electricity development and to develop hydro-electricity reducing its adverse effects on environment to a minimum level.

15. The emphasis on power development follows the adoption of the Hydropower Development Policy in the early 1990s which, combined with changes in electricity legislation and the opening up of the power sector to local and foreign private investments, was intended to make institutions operating in the power sector efficient and creditworthy, as well as increase the participation of the private sector. Two medium-sized projects have already been concluded within this framework. In mid-1996, the 60 MW Khimti Khola project reached financial closure after four years of preparatory work. In early 1998 agreements for the 36 MW Upper Bhote Khoshi power plant were signed.

16. While under this new policy and regulatory framework HMGN has been able to attract private (foreign) investments, sector institutions are still neither efficient nor creditworthy. The trade-offs between water and power use have only recently been considered as part of the comprehensive Water Resources Strategy. Experience over the last few years has shown a lack of transparency in project planning and selection; absence of competition; growing conflicts of interest between entities involved in the sector; cost of electricity reaching the limits of affordability; and growing frustration about the inability to mobilize private and public capital to exploit Nepal's water resources potential.

#### *The Need for Investment*

17. Although precise estimates are difficult to make, taking into account even the conservative estimates for projected growth in demand for electricity, the financial resources required to fund the expansion of the power sector for the domestic market alone vastly exceed the availability of funding from the traditional multilateral and bilateral agencies. Over the next ten years, the Power System Masterplan estimates generation investment (under the Masterplan's recommended hydro only scenario) at US\$830 million, based on a 7.8 percent rate of load growth in the base case forecast. This estimate excludes any additional investment for dedicated export projects. Therefore, if one adds funding requirements for export-oriented projects the need for raising private capital is even more evident.

18. Resource mobilization for T&D investment poses equal challenges. The high technical losses reflect lack of investment in the distribution sector and its inability to mobilize adequate financial resources. Indeed, one of the most important reasons for privatization of distribution is to be able to attract the necessary capital. The Masterplan estimates transmission investment at US\$940 million over the next ten years. The combined investment need for generation and transmission, estimated at US\$1.77 billion for the next ten years, vastly exceeds NEA's capital expenditures of US\$730 over the period 1991-

98 (of which roughly US\$490 million was raised from loans and US\$ 180 million in equity).<sup>8</sup> Even if NEA manages to generate 25 percent of the sector's expected capital needs through internal cash generation, the balance will have to come from external sources. Resource mobilization from internal NEA sources poses a serious problem given the existing financial state of NEA.

19. A series of tariff increases (60 percent in November 1991, 25 percent in March 1993, 38 percent in March 1994 and 20 percent in June 1996) enabled NEA to substantially improve its financial position by the mid-nineties. Since then, however, NEA's finances have weakened due to several factors: (i) the Government did not allow any tariff adjustments until November 1999 when it approved a 28 percent increase; (ii) NEA's system losses remains high - a major source of inefficiency and financial weakness; (iii) increasing costs, partly due to the devaluation of the Rupee; and (iv) a rapidly growing generation investment program has contributed to financing needs. As a result, NEA's rate of return on its assets, which had improved to 1.8 percent in FY96 has fallen steadily to an unacceptably low level of 0.3 percent in FY99 (Table 5). Although NEA is able to fully service its long term debt and meet its royalty payments for water and income tax liabilities to the Government, its contribution to its rising investment program (as measured by its self-financing ratio) has been inadequate (Table 5).

Table 5: NEA's Financial Summary, FY95 – FY99					
Total Operating Revenue (Rs. Million)	3,464	4,012	5,084	5,433	5,770
Self Financing Ratio (%)	26.3	12.5	40.6	22.4	10.1
Rate Of Return (%)	1.5	1.8	1.7	0.6	0.3
Debt Service Coverage Ratio (%)	1.3	2.7	2.0	1.7	1.5
Operating Ratio (%)	94	92.8	86.1	96.8	97.3

Source: Nepal Electricity Authority

20. Clearly, the capital needs of developing Nepal's power sector are large and appear to be well beyond the capacity of HMGN. The availability of concessional official resources for the development of the power sector is declining, and scarce public resources are needed for the development of the social sector. Increasingly, therefore, investment resources for power development will need to be mobilized through the private sector. Even a public sector enterprise such as NEA will have to rely increasingly on internal resources and private capital markets, which requires NEA to be creditworthy.

### ***The Challenge***

21. Thus, the primary challenge facing Nepal is to generate sufficient financial resources to expand its power supplies in an environmentally sustainable and socially acceptable way<sup>9</sup> to meet the needs of its people, both in the rural and urban areas. This is to be done in a least-cost way that makes power affordable to domestic users and allows Nepal exports to maintain a position of comparative cost advantage. The strategy to expand power supplies, and provide access to these supplies to the majority of consumers, is inevitably linked with the paramount goal of poverty reduction. Not only does electricity serve as an important factor of production, fueling industrial progress and income growth thereby improving living standards; there is sufficient evidence on the positive impact access to electricity has on the lives of the poor. While HMGN's developmental objectives for the power sector as outlined in the

8. Based on rupee estimates in the financial accounts and using Rs 50/US\$ as the average exchange rate for the mid 1990s.

9. A recently published report (November 2000) of the World Commission on Dams, "Dams and Development – A New Framework for Decision-Making" provides, *inter alia*, strategic priorities and guidelines to decision-makers for the future development of dams.



Ninth Plan are commendable, and progress has been made in developing policies and regulations to meet developmental objectives, institutional constraints pose a challenge to implementation. The problems facing Nepal are related to institutional factors. For example: the overlaps in the roles and responsibilities of public sector institutions, conflicts of interest and inefficiencies of the NEA system; are some of the fundamental reasons behind the high cost of power in Nepal. These institutional factors also restrict Nepal's ability to mobilize investments for export oriented projects. Such projects are relatively large and could benefit from economies of scale and help to build a power supply system, which is better matched to the demand patterns.

22. Thus, a policy to reduce costs should be oriented towards institutional change that promotes clarity of functions and roles, efficiency, creditworthiness, and trade. Lower cost of production, while improving the comparative advantage of Nepal's exports, would allow development of the domestic market by making power more affordable to the population.

#### **IV. The Roles and Responsibilities of Public-Sector Institutions**

23. The existing institutional arrangements are presented in Annex 2. Under the current framework, there is no clear separation of policy, regulatory and operational functions in the electricity sector; and coordinating bodies designed to ensure consistent policy making between sectors are not functioning adequately. Collectively, there are about 14 institutions, which in combination with a multi-level approach have led to conflicting roles and responsibilities. There are six institutions involved in policy formulation and the extent of overlap between the five main entities active in power, viz., Ministry of Water Resources (MOWR), NEA, Electricity Development Center (EDC), Water and Energy Commission Secretariat (WECS) and Electricity Tariff Fixation Committee (ETFC) is illustrated in Chart 1 (see Executive Summary).<sup>10</sup>

24. There is an urgent need for seeking a consensus among the agencies on their respective roles in sector development; planning, licensing and regulatory regimes; water resource development for multipurpose and export projects; and private sector investment in the power sector. Rationalization of Government agency roles and responsibilities is also a fundamental requirement to meet the Government's objectives of developing a new industry structure.

##### ***Need for Introducing Institutional and Structural Changes***

25. As demonstrated earlier, with the adoption of a series of new policies and laws in the early nineties and the Ninth Plan, the Government has recognized the need for greater private sector participation in both the water and power sectors. Sub-sectors which use water, such as water supply, sanitation, irrigation and hydropower, have their own sub-sector policies and guidelines, but the responsibility for the management of water resources remains spread over 9 ministries and 16 departments. The institutional set up has not been adapted to adequately support the implementation of the new policy directions articulated in the Ninth Plan, which recognizes: (a) the shift from pure public sector development to increased private sector and community based participation; (b) the relative decline in the availability of concessional multi- and bilateral resources which drives the need to create an environment in which mobilization of private capital for the development of the sector is possible; and (c) the need to increase access to electricity and protect the interest of consumers against natural monopolies.

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10. In few areas however, the functional role of institutions such as WECS is limited. For example, the role of WECS in project identification is limited only to inventory studies; and to the identification of small private hydro power projects. MOWR sets the policy, and DOED is the executing body.

26. The Government has recognized that next to human resources, water is the most important resource of Nepal. HMGN has already started the formulation of a National Water Resources Strategy to determine how and to what extent the water sector can lead the acceleration of economic growth. Apart from inputs from technical experts, the strategy formulation is set up as a participatory process. Issues and problems were identified in the first phase, and in stage I of the second phase, strategic policy options are being further worked out. One can already see that there is a rapid growth in demand of various water uses, which is leading to both inter-sectoral and inter-regional conflicts as well as opportunities. Under the current set up, it is difficult to assess impacts and trade-offs in another sector and region; therefore, an integrated approach to water resources management is needed. Conflicts in water allocation can only be avoided by taking a river basin planning approach. The recent policy shift towards increased private sector involvement makes this approach even more relevant. There are many pending issues, however, that need to be resolved, such as those dealing with the overall inadequacies of the legal and regulatory framework and those concerning water rights with the downstream riparian nations. These issues are beyond the scope of this sector report and are being addressed within the context of the Water Resources Strategy formulation.

### ***Streamlining Policy Making Bodies***

27. There appears to be consensus that the river basin would be the fundamental planning unit in order to minimize future conflicts with irrigation and other water uses. Also, WECS has recently been strengthened to include representatives of all ministries involved in the consumptive and non-consumptive use of water. While there is probably no ideal way to structure policy making bodies, this recent change appears to conflict with the role of the Water Resources Development Council, and consideration should be given to consolidating the entities which provide technical policy advice. EDC's role should be concentrated on implementing policy. In addition, the delineation of responsibilities for certifying and monitoring compliance with environmental and social safeguard policies between MOWR/EDC and Ministry of Population and Environment (MOPE) needs to be clarified. Experience in most countries would suggest that this responsibility is best placed in the Nepal context with MOPE, and not with the licensing authority.

28. Many of these issues have been highlighted in analytical studies conducted in the last few years; however, rather than clarifying the role of existing entities or modifying existing policies and guidelines, the reaction has been to create new umbrella organizations or coordinating committees thereby compounding the problem. It has also often lead to paralysis in decision making. Some reports have argued that WECS should be attached to the National Planning Commission (NPC); others have proposed that WECS be attached to the Prime Minister's Office given the importance of water resource for Nepal. Both solutions could work. This issue, together with a review of the existing policies and legal framework, is being studied as part of the Water Resources Strategy formulation and is not further discussed in this sector report. From the perspective of the power sector, of crucial importance is the fact that a clear and consistent policy framework is in place which is based on sound technical analysis and has the necessary political support to be implemented.

### ***Rationalize Planning***

29. Nepal is an international front-runner for having introduced an environmental and social assessment process which requires review and public consultation regarding the environmental and social impacts before license determination is considered. A first example has been the Medium Hydropower Study in which 145 projects, in the range of 10 MW to 300 MW, were screened and ranked taking environmental and social impacts explicitly into account. The screening and ranking exercise has served as input to the formulation of the Power Systems Master Plan for NEA. Similarly, Nepal is a front-runner in the way national consensus is being sought in the formulation of the new Water Resources Strategy, through a bottoms-up, participatory approach. In that respect, the river basin planning approach, with a

mix of strong technical inputs and public participation, is fully supported. The overall water resources planning will have to provide the parameters within which power systems planning is undertaken. Within the Nepal context, power systems planning is a clear operational utility function and does not belong in the Government; yet, in the long run, planning belongs in an unbundled entity of NEA responsible for the planning function. However, the current industry structure leads to undesirable conflicts, which as experience has shown in other countries, can only be resolved through the unbundling of NEA over time (as explained in Chapter V). This includes particular anticipation in an increasing role of private investment and the objective to export power to neighboring countries.

30. The creation of an Independent Market Operator (IMO), as suggested in Chapter V, would facilitate the introduction of competition for and within, the market over time and ultimately help reduce cost to electricity consumers. It would also be necessary to provide open access to the transmission system to clients of the generating companies both within Nepal and abroad. The need for change at the operational level (in NEA) is not just driven by efficiency consideration, but also by the compulsion for developing a framework for attracting private investments, because it would create a clear set of market rules.

### ***Separate Regulation from Policy***

31. In most mature regulatory systems in the world where there is significant private sector participation in the power sector, independent regulatory authority is established free from interference from the line ministry responsible for policy making. Responsibility for licensing, retail tariff setting and protection of consumer interests is normally included in the functions of the regulatory authority. For Nepal, a case could be made to combine most of the functions of EDC and ETFC into a regulatory authority independent from MOWR, but without the current investment promotion functions of EDC. In the medium term, this option should be seriously considered and implemented in coordination with the decision to unbundle and gradually privatize distribution. The merits of a multi-sector regulator (for example, water supply, electricity and possibly telecommunication) should also be explored given the relatively small size of the system. This would enable a pooling of scarce resources and possibly lower the cost of regulation.

32. In the short run, consideration could be given to expanding the existing licensing system for transmission and distribution and begin regulating the monopolistic parts of the system by issuance of a more comprehensive license which would also cover tariff setting. The role of the Electricity Tariff Fixation Commission (ETFC) would be to monitor compliance with the license conditions. These licenses could be designed in such a way that transparent formulas are agreed upon for operational efficiency and tariff setting; this would allow tariffs to be automatically adjusted after the entity has demonstrated, to the ETFC, compliance with the license conditions. This could be applied to private as well as public licensees. A comprehensive review of the ETFC was completed in August 1996 as part of the United States Agency for International development (USAID) sponsored Private Electricity Project. These resulting recommendations should be reviewed once a consensus on the future industry structure has been reached. It should be anticipated that a comprehensive amendment of the existing regulatory framework would be desirable.

33. As part of the preparation of the proposed Power Development Project (PDP) (being prepared with support from The World Bank), EDC, with the help of USAID consultants and Bank staff, has been designing a competitive bidding process for medium scale hydropower projects; the first Requests for Qualifications have been issued and proposals received.<sup>11</sup> There is not much experience around the world

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11. A comprehensive environmental and social impact assessment framework for the project has been prepared by the HMG. NEA has carried out the Screening and Ranking (S&R) exercise to build up a pipeline of projects for the Power Development Fund. The S&R exercise aimed at reducing project implementation risks by selecting hydro-electric schemes through a transparent and public process, using explicit environmental and social criteria in addition to application of techno-economic

in competitive bidding for hydropower projects; this effort is aimed at attracting serious private investors through a transparent bidding process. It is expected that this would help to reduce costs and likely lead to much better results than the open solicitations issued by EDC in the past where there are no clear criteria established to select qualified bidders.

34. For projects below 10 MW, a buy-back policy is already in place, and the first contracts are currently negotiated on the basis of that new policy. For medium-size projects, competitive bidding should be tested as soon as possible and modified as experience is gained. The tariff profile bid would be cost based. The sale price would depend on royalties and royalty sharing agreements reached between the concerned parties. It is suggested that the royalty sharing principles be agreed in advance of any bidding. For larger size and multi purpose projects, appropriate procedures for introducing competition need to be formulated on a case by case basis. One option would be to require competitive bidding for all major contracts.<sup>12</sup> For bigger projects, which cannot be adequately defined in advance of the bidding, another approach would be to recommend a two-stage solicitation procedure. In the first stage the developer is selected competitively, after which he works with the resource owner and/or power purchaser to complete preparation/financing feasibility studies, power sales agreements up until financial closure. In view of the substantial construction risks associated with large hydropower projects, risk allocation forms a very important part of these second stage studies. Suitable public-private partnership formulas will need to be worked out, particularly for dealing with social and environmental impacts and for risk sharing.

### ***Improve Climate for Mobilizing Private Capital***

35. Compared to most developing countries, Nepal already has a fairly comprehensive framework in place to promote private investment. However, Nepal needs to be better organized than its competitors in dealing with the private sector in order to take full advantage of this situation. Having established EDC as a one-stop shop is a good first step, but its functioning needs to be improved and capability strengthened. Equally important is the need to address the issues of overlapping responsibilities, regulation, and system planning raised in the paragraphs above. Finally, the restructuring of NEA is considered an important element for attracting private investment, not just from the standpoint of creating creditworthy off takers and improving efficiency, but also for creating a set of transparent operational market rules.

36. It is expected that some concessional funding will continue to be available, and optimum use should be made of these sources in areas where they are most needed. Improving access to electricity in rural users appears to be the obvious priority area. Another reality is the shallowness of the local debt and equity markets and the limited access to international capital markets. One example of an innovative financing technique is the proposed creation of the Power Development Fund (PDF) which will essentially be administered by a private sector institution based on sound financial criteria under policy guidelines determined by the Government. This is an attempt to get maximum leverage from the available concessional resources. The PDF is designed in such a way that ultimately, domestic savings could also be routed through the fund. Further reforms in the financial sector will be necessary, and the initial steps are being designed as part of an overall economic reform program.

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data. Feasibility studies have been prepared. The implementation framework for the proposed PDF has been drafted. Solicitation documents for competitive bidding of selected hydro schemes have been prepared. The project supports recommendations emerging from the S&R study for the development of small and medium-sized projects (10-30MW) considered appropriate for meeting Nepal's domestic demand for electricity in the medium term. A few schemes include some seasonal and/or daily storage to provide year-round peaking capacity, complementing the smaller run-of-river projects that have low dry-season peaking capacity.

12. A number of Indian hydro IPPs have adopted this model in which individual work packages (civil, electrical, turbines etc) are subject to International Competitive Bidding (ICB). Competitive bidding at the level of turnkey EPC contracts (though widely used in Indian thermal IPPs) is more problematic in the case of hydro because costs may be 20-30% higher than the traditional multiple contract model due to layering of risk margins on the sub-contract structure.

37. Private sector investors have expressed their views (through workshops and written documents produced by the Chamber of Commerce) about how the framework for private investment in hydropower could be notably improved. While some of the recommendations may not be in the wider interest of the economy, several do warrant serious considerations. On the international side, there is enough evidence that private niche investors continue to be interested in investing in hydropower in Nepal. Open and transparent bidding processes combined with other measures would have the best chance of attracting serious investors. Efforts should also be made to smooth out process that presently concern private investors. Delays, disputes and extensive paperwork for custom clearance for project equipment and materials head the list. This is followed by issues involving visa renewals. Addressing these issues is important for attracting private investments given the inherent risk profile of hydropower in general.<sup>13</sup> Some of these issues are addressed in the new hydropower policy, although implementation would remain a challenge.

#### ***Action Plan***

38. The following actions should be considered as soon as possible:

- Finalize the preparation of the National Water Resource Strategy and create national consensus on basin development.
- Consider consolidating technical policy advice on water resources development into one entity and eliminate overlapping responsibilities within MOWR.
- Clarify responsibilities for monitoring and enforcing compliance with environmental legislation between MOPE and MOWR.
- Rationalize planning functions.
- Finalize the comprehensive review of the EDC licensing procedures and regulatory function of the ETFC, and consider the establishment of a separate regulatory authority.
- Accelerate creation of the PDF and initiate a competitive bidding process for medium size hydropower projects.
- Prioritize agreed institutional and policy changes and start implementation.

## **V. Institutional Restructuring of NEA**

#### ***Rationale for NEA Restructuring***

39. While in the South Asian regional context NEA, as an integrated utility, has been performing better than many other publicly owned utilities, the fundamental question is how the Nepalese power sector is to mobilize the necessary financial resources for future growth. Although Nepal has been able to attract Independent Power Producers (IPPs) for smaller hydro projects, it is doubtful that the private capital necessary for the much larger future facilities contemplated by NEA's generation expansion plan (such as U. Karnali and Arun), could be mobilized under the present setup which is characterized by: weak operational efficiency;<sup>14</sup> insufficient creditworthiness to allow access to private capital markets; and growing conflicts of interest with existing and new IPPs, some of which are joint ventures between private investors and NEA and for which NEA is also the principal buyer. Furthermore, NEA, as the

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13. Consultants financed by USAID are currently working on a review of the licensing process and the functions of EDC. These reports are expected to be ready in the near future. There appears to be recognition that competitive bidding for the market should be introduced as soon as possible and that the licensing process could be significantly improved and made more transparent.

14. Level of T&D losses, system reliability etc. (See Annex 3)

owner of the transmission and load dispatch system, has conflicts of interest with regard to opening up grid access to private IPPs since NEA decides what IPPs can and must do.

40. There are examples in the developed world of integrated utilities operating at reasonable levels of efficiency.<sup>15</sup> However, there are very few examples in developing countries demonstrating that integrated, publicly owned utilities develop into efficiently operated entities with adequate access to private capital markets and resolving, at the same time, the conflict of interest issue combined with significant entry of private IPPs in the market. Particularly in South Asia, there are few publicly owned integrated utilities that operate at reasonable commercial performance and efficiency. There is no better example than India, where the privately owned utilities – Bombay Suburban Electricity Supply (BSES), Calcutta Electricity Supply Corporation (CESC), Ahmedabad, Tata – all have significantly lower T&D losses, and significantly better creditworthiness, than their publicly owned counterparts. Moreover, there is growing experience that an unbundled power supply system with significant private ownership in distribution, if appropriately regulated, would be able to provide over time much better service delivery at much lower cost. Therefore, developing NEA, as an integrated publicly owned utility cannot be considered as a sustainable option.

41. The availability of concessional multi- and bilateral sources of funds is declining in comparison to investment needs. There is also a growing reluctance on the part of governments to continue to subsidize a relative affluent part of the population which has access to electricity. Furthermore, there is growing evidence around the world that power systems' unbundling and privatization, particularly of the distribution system, may be the only option available, even for a relatively small system like Nepal,<sup>16</sup> to successfully attract private capital. Nepal must face the fact that practices of the past when concessionary finance was allocated by governments and multi-lateral institutions on the basis of need, are changing. Private capital markets are international in nature and will be attracted on the basis of efficiency, transparency, and rate of return, in which comparisons with other investment opportunities are made on a worldwide basis.

### ***Restructuring Options for NEA***

42. A review of the worldwide experience shows clearly that there is no unique formula that can be held up as a universal model. Each country has unique problems, resources, and institutions, and no two situations are exactly alike. The worldwide experience also shows that successful reform programs require ownership by the Government and the people – whatever reform option is chosen must have a rationale that enjoys broad support among the Government, the various stakeholders, and consumers. Again, India illustrates this point: reform has been successful where there is broad, cross-party political and public support, and where stakeholders (such as labor unions) have been brought into discussions at a very early stage – but less successful where these factors have been absent.

43. Based upon the worldwide experience, there are several models of possible restructuring and reform that NEA can consider (described in the detailed background report). Some of the possible options include:

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15. Prior to unbundling in such countries as the UK and New Zealand, and Electricite de France still today, many such utilities operated with low levels of T&D losses and were entirely creditworthy. However, even in such cases, unbundling and reform have brought further efficiency gains in the wake of greater competition in generation and dispatch, and reorientation of the distribution business as a consumer-oriented service provider.

16. Experience in Bolivia and Central America demonstrates that even relatively small power companies can be privatized successfully, proving that the power business can attract interest from private investors if properly prepared and an appropriate regulatory system is in place.

- Internal reforms (in which NEA's functions are internally separated through creation of profit centres);
- Spinning off NEA's joint ventures as separate companies;
- Unbundling generation, transmission and distribution (along the lines of the Orissa and Andhra Pradesh [AP] models in India, sometimes called the single buyer or Independent Market Operator [IMO] Model);
- Privatization of unbundled entities – and again there are several options, ranging from outright sale to joint ventures with minority government participation (or with so-called “golden shares,” an approach used in some United Kingdom privatization's of public companies;
- Divesting at-least 10 percent of NEA's shares (as already anticipated under the NEA Act) and reconstitute the current Board of Directors, chaired by the Minister for Water Resources, with a professional board. However, given NEA's current financial position, it may be difficult to find investors in the short run. Another possible route prior to privatization would be to amend the NEA Act and reconstitute the NEA Board of Directors with a majority of private sector representatives;
- Management contracts. Though the Orissa experience, where such contracts failed and were abandoned, shows this to be a difficult concept to successfully implement; and
- Wholesale Market Model. In a competitive wholesale electricity market, individual generators compete for the dispatch of their hourly basis, thus introducing competition in the market at this level. This model cannot be introduced in Nepal in the medium term and could only become a realistic option once creditworthiness is fully restored. This implies several years of successful operation of unbundled distribution companies under the IMO model. Privatization of distribution is a key element of the IMO model.

44. While there are several options to unbundle the Nepal's power system, a possible option would be to differentiate entities by functions and responsibilities as follows: NEA would be reorganized into two Integrated Generation and Distribution Companies (IGDs); one Distribution Company; one Generation Company; and one Transmission Company with the load dispatch centers. Other variants are possible while maintaining the same principles and objectives and would require further study. The existing (retention of a vertically integrated monopoly with some of the recent initiatives to promote IPPs) and alternative industry structure, characterized as a variant of the IMO Model are illustrated in Charts 2A & 2B (see Executive Summary). An important feature of this variant of the IMO model is that it permits distribution companies to have generation (integrated-generation companies), and these companies can trade excess energy with other generators and distributors. It therefore does not involve a complete separation of the system into generation, transmission, and distribution companies as typically implied by unbundling. The model and its suitability for Nepal are discussed in more detail in the background report<sup>17</sup>.

#### ***Possible Issues Related to the Restructuring Options***

45. There are a very large number of potential options for unbundling NEA. Particularly in distribution, there are many options for possible definitions of service territories of unbundled units and in the way in which rural electrification schemes and small generating units could be attached to such units. While the detailed background report outlines one possible route to unbundling—which has been worked to illustrate how unbundled sector might look like—final decisions cannot be undertaken without detailed

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17. While there are several options to unbundle the Nepal power system, a possible option would be to differentiate entities by functions and responsibilities as follows: NEA would be reorganized into two Integrated Generation and Distribution Companies (IGDs); one Distribution Company; one Generation Company; and one Transmission Company with the load dispatch centers. Other variants are possible while maintaining the same principles and objectives and would need further study.

consideration of several important issues, whose resolution goes beyond the scope of the present study. Some of the issues that need to be considered include:

- How service areas can be defined such that viable businesses can be created. This involves careful analysis of customer mix, the condition of the technical infrastructure in each area, etc. Furthermore, for each potential business unit, a financial model has to be created so that viability can be assessed quantitatively. Experience shows that the goal of a geographically contiguous service territory often conflicts with the goal of financially viable consumer mixes.
- Every potential business unit requires management, staff, and transfer schemes necessarily requiring considerable detail. While the separation of generation usually involves relatively few issues (because of staff specialization), assignment of employees between the transmission and distribution units frequently involves long and time consuming discussions with labor unions and staff associations (without whose support unbundling is very difficult).
- One of the main issues in defining viable business units is the assignment of liabilities. Detailed financial analyses and modeling can reveal the issues that need to be considered in ensuring that each business unit starts with a healthy balance sheet. Who assumes any unfunded liabilities is a particularly vexatious issue.
- Experience shows that delineation between “distribution” and “transmission” is far from straightforward and involves detailed study of voltage levels, the location of substations, and the topology of the sub-transmission system.
- While the separation of generation is required under most alternative models, there is the question of which of the smaller generating units (particularly in the more remote areas) are better left with the distribution company in whose service territory it is located. Even if one accepts the IMO and the separation of generation, transmission and distribution as the general model, exceptions may need to be made to avoid proliferation of small companies.
- Ultimately, the objective is to attract private capital into the sector without the need for government guarantees. Achievement of this objective may require transition arrangements for IPP security packages involving escrow arrangements, whose geographical distribution may complicate unbundling.

46. As shown above, the preparatory work required to make robust decisions for unbundling is significant. Experience elsewhere shows that this may take several years to achieve and will require detailed financial, economic and technical analysis. Unbundling may also need to occur in several steps. Even in New Zealand, often held up as a model, the Electricity Corporation of New Zealand was unbundled over seven years in several stages. In India, unbundling in several states (Orissa, Haryana, and AP) has occurred in stages – first a separation of generation; then a split between transmission and distribution companies, with all entities still fully-government owned. Only in a third stage, once the unbundled entities have established new management and the regulatory commissions have established some track record of independent regulation, is private capital brought in. Examples of various approaches to power sector reform in some counties and states are presented in Annex 4.

47. Whatever model of institutional reform is followed, there are certain principles that apply everywhere for private capital to be successfully mobilized:

- Eliminate conflicts of interest: Private investors want to see a level playing field and transparency. But, NEA, as the owner of the transmission and load dispatch system, has conflicts of interest with regard to opening up grid access to private IPPs since NEA decides what IPPs can and must do. It is also hard to argue a level playing field where NEA



participates in joint ventures with some private investors, while at the same time being the principal buyer of electricity from all projects – its own, joint venture projects, and IPPs.

- Improve creditworthiness: Private generation projects cannot be brought to financial closure in the absence of creditworthy buyers. Fundamental to creditworthiness is operational efficiency – yet that of NEA is still weak.
- Improve opportunities for attracting private capital into distribution by unbundling. Without unbundling of some kind, it is difficult to attract adequate private capital for distribution system expansion in a vertically integrated utility.

48. To be efficient, the new structure needs an appropriate regulatory framework for the operation of the system and technical and commercial rules for operation of the Nepal grid. Provided it is properly designed, this will ensure: creditworthiness of corporate entities involved in the sector; an efficient centralized economic dispatch; transparency that minimizes discriminatory risk for private investors; clarification of quality standards; minimization of conflicts, as the operation that is “right” is defined in the rules; improve efficiency and quality of service, as reliability and economic dispatch become an obligation for all; and exercise of market power will not be possible.

### ***Potential Benefits of Restructuring***

49. It is recognized that Nepal, compared to other countries with similar size power sectors, may have a lower per capita income and may lag behind in human resources development. While these factors may influence the pace of restructuring, it does not take away the need to implement reform. It should also be borne in mind that privatization is not a panacea, nor is unbundling an objective in itself. Unbundling and privatization are used in the restructuring of the electricity sector as a tool to improve efficiency, establish creditworthiness and attract private capital. In general, the aim has been to benefit consumers through better tariffs and improve quality and access to electricity services.

50. The benefits of unbundling can be measured in terms of the following:

- Diversification of the number of buyers and sellers, allowing direct competition and/or competition by comparison and increasing the dynamics of the sector.
- Specialization in each activity, increasing the possibilities of improvements in each step of the supply chain.
- Transparent and non-discriminatory access of the grid and distribution network.
- Transparent and non-discriminatory operation of the system and its restrictions.
- Specific regulation for each activity, creating for each economic incentives to improve quality and supply at reasonable tariffs.
- Creation of conditions in which the investor is willing to take additional risks, because he can also receive additional benefits, and in this way decrease the risks that are assigned and passed through to consumers and tariffs.

### ***Action Plan During the Transition Period***

51. Experience elsewhere shows that whatever model of institutional reform is adopted, this will involve a step-wise procedure, with each step of the transition period requiring several years. This is true for Nepal, given the limited managerial resources and labor constraints facing the country at present. In these areas, Nepal is well behind Latin America at the time that region embarked upon the transition to structural changes in the power sector. However, despite the need for a gradual approach, it is recognized

that final decisions cannot be undertaken without detailed consideration of several important issues – whose resolution goes beyond the scope of the present study. Thus, urgent preparatory work is required to make robust decisions about what the ultimate market structure should look like. Some of the issues that need to be considered include:

- How can service be defined such that viable businesses can be created. This involves careful analysis of customer mix, the condition of the technical infrastructure in each area, etc. Furthermore, for each potential business unit, a financial model has to be created so that viability can be assessed quantitatively. Experience shows that the goal of a geographically contiguous service territory often conflicts with the goal of financially viable consumer mixes.
- Every potential business unit requires a management and a staff, and transfer schemes necessarily require great detail. While the separation of generation generally involves relatively few issues (because of staff specialization), assignment of employees between the transmission and distribution units frequently involves long and time consuming discussions with labor unions and staff associations (without whose support unbundling is very difficult).
- One of the main issues in defining viable business units is the assignment of liabilities. Only detailed financial analysis and modeling can reveal the issues that need to be considered in ensuring that each business unit starts with a healthy balance sheet. Who assumes any unfunded liabilities is a particularly vexatious issue.
- Experience shows that delineation between “distribution” and “transmission” is far from straight forward, and involves detailed study of voltage levels, the location of substations, and the topology of the sub-transmission system, before the interface/voltage level (and metering) points between the distribution companies.
- While the separation of generation is required under most alternative models, there is the question of which of the smaller generating units (particularly in the more remote areas) are better left with the distribution company in whose service territory it is located. Even if one accepts the IMO and the separation of generation, transmission and distribution as the general model, exceptions may need to be made to avoid proliferation of small companies.
- Ultimately the objective is to attract private capital into the sector without the need for government guarantees. Achievement of this objective may require transition arrangements for IPP security packages involving escrow arrangements, whose geographical distribution may complicate unbundling.

Furthermore, effective and sustainable changes require early attention to addressing the concerns of labor unions (on a wide range of issues concerning employment conditions and pension rights), as well as education both within NEA as well as to the broader public on the objectives and benefits of reforms.

## **VI. Power Trade**

### ***The Market for Exports***

52. The potential market for power in India—and particularly the Northern Grid Region that lies to Nepal’s west—is large indeed. The Northern Region—Uttar Pradesh (UP), and Delhi—faces chronic power shortages which are likely to continue in the foreseeable future. This region could considerably benefit from power exports from Nepal. The Indian Central Electricity Authority (CEA) has estimated a shortage of roughly 10,000 MW in the Northern Region at the end of the Tenth Five-Year Plan (2007).

At the same time, Nepal has a significant hydro resource base that is far greater than its foreseeable domestic requirement, presenting an opportunity for regional trade that may bring substantial economic benefits to both nations. By 2020, Nepal's total domestic power demand is estimated at around 1,650 MW, compared to a hydro potential of about 43,000 MW. It is evident that there is significant scope for exports without compromising likely domestic requirements.

### ***Constraints on the Indian Market***

53. However, the very conditions that have led to the presently very large shortages of power in India, which is the market opportunity potentially filled by Nepalese hydropower, also constrain any large-scale absorption of Nepalese exports. In large measure, the present shortages are a consequence of the financial condition in which Indian State Electricity Boards (SEBs) now find themselves: almost without exception, they are effectively bankrupt, and commercially uncreditworthy. The resulting problems of financing Indian IPP projects—which has led to extensive delays in implementing new generation—apply equally to any dedicated generation projects that are located in Nepal. Even in the case of surplus power sales, timely payment from insolvent SEBs is highly unlikely.

54. There are formidable hurdles constraining the realization of this potential opportunity for trade. It must be recognized that Nepalese hydro projects compete with Indian hydro projects (located in such states as Himachal Pradesh and UP) that are quite similar in hydrological and geological conditions. The first requirement for such trade to occur, therefore, is that the costs of Nepalese hydro projects fall significantly below those of the corresponding Indian projects so that there is enough benefit for both parties to share. Even in the case of “surplus” hydro power from Nepal's domestic projects, for this to be sold in India on a large scale requires that its price be below that of the variable cost of off-peak thermal power that it would displace.

55. Nepal's fundamental power sector development dilemma follows from its small size compared to its Indian neighbor. In a perfect world, Nepal would be synchronized to the Indian grid and its system developed as part of the Northern and Eastern Indian regional power pools. This would permit optimal development of Nepal's hydro resources in large storage-hydro projects that can exploit significant scale economies, serving the needs of the power pool as a whole. In addition, enabling Nepal to draw upon India's thermal power resources for optimal reliability and economic power system development. The utilities in both countries would operate on commercial lines and in accordance with international standards of grid discipline; creditworthiness would make routine the transactions that characterize inter-utility power pool electricity transfers elsewhere in the world. The benefits of such transactions are evident from countless examples throughout the world. For instance, the economic benefits of interconnection and power trading in place of self-sufficiency have recently been studied for the Greater Mekong Sub-Region (involving the countries of Cambodia, Laos, Myanmar, Thailand, Vietnam, Malaysia and Singapore). The cumulative saving over the period 1997-2020 for the trading case compared to a self-supply case is \$13.7 billion.

56. However, such a perfect scenario is at least 20 years distant. For the foreseeable future, Nepal has to deal with the high domestic cost of electricity. We believe that in addition to the institutional changes proposed above, promotion of trade through regional inter-connections would contribute towards this objective by reducing the cost of power. While we recognize the importance given by HMGN to self-sufficiency, clear economic benefits to importing cheap energy need to be considered: coal-based power from India's eastern region, likely to be in surplus for some time, could be imported over the same asynchronous transmission link as would be used for export of surplus hydropower.

57. Another approach for reducing the cost of power is to mix new power with old power. A common feature of the power systems incorporating a large proportion of old hydropower capacity is very low consumer tariffs, well below economic cost, as rents developing in later years are passed on to consumers. The overall cost of the new project might therefore be lower when combined with an existing project

within one company.<sup>18</sup> This approach of combining the solicitation of new power with the sale (or transfer of ownership for a fixed period) of existing hydropower plants also have the effect of:

- Diluting risk. New hydropower plants have high construction risks, whereas an established project has no construction risk and very low operating risks. Market risks, to the extent that they are not taken by the power purchaser, can also be diluted since a large proportion of the joint output is dedicated to an existing market rather than a market which is assumed to be developed over the construction period of the new project.
- Providing construction cash flow from the existing plant to serve the new one through securitization: In its simplest form, an existing power plant or group of power plants is formed into a company and lists shares on a local or foreign stock market. Funds raised are used to finance new generation investments by the listed company, supplemented by cash flow from the existing plants during the construction period. Securitization of existing assets to finance new power development has been used successfully in China.<sup>19</sup> The Gezhouba hydropower project, listed on the Shanghai market, was used in this way to help finance the Three Gorges Project. There are also several examples of thermal plant assets being aggregated into companies which are then listed on foreign exchanges although in all these cases majority ownership has remained in local hands. There are also cases where debt financing has been raised on a similar basis such as the Shandong Zhonghua Power Company, again a joint venture, but in this case with majority foreign ownership.
- Opening up Long term debt possibilities. Although currently not available to Nepal, long term debt (for example from US 144A bond market) or other international institutional investors is more likely to be available for an established project with a demonstrated stable cash flow than for a green-field project with a revenue stream commencing four or five years down the track

58. There are numerous possibilities for structuring such a deal including variations in the ownership structure of the plant, timing of returns on assets transferred etc. However, such an arrangement provides a method of securitizing existing assets in which Nepal has developed considerable equity arising from inflation or from the concessional terms of the original financing.

### ***Recent Developments in India – Improving Prospects for Trade***

59. Notwithstanding the problems discussed above that could potentially constrain power trade with India, there are several positive developments recently in India that may enhance the opportunities for Nepalese hydropower exports. Developments in India (presented below) such as the Power Trading Corporation (PTC) and the financial restructuring of the state electricity boards with the aim of making the power sector creditworthy in India, improves the prospects for developing power pool trading arrangement into which Nepal could sell its output. Such pools may either be on a gross—where all power is sold through the pool—or net basis, where only power not already sold under physical bilateral contracts is traded. Successful pools however require, *inter alia*, mature and robust commercial environment, and competitive electricity markets, under which individual generators compete for the

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18. In the current rush to privatization, there is a danger that the owners of these assets (and others in the overall system), will not realize their intrinsic value because the market price will reflect the present value of the low existing tariff, rather than the replacement value of the existing assets. It is therefore important that as part of the privatization process, tariffs are raised to sustainable levels, which, after full transition, will be the long run marginal cost of expansion in the system. Where there is a large discrepancy between existing and economic prices, a gradualist approach to privatization appears to be warranted.

19. Barry Trambath, "New Hydro for Old - A Way around Barriers to Hydropower Development", World Bank, Washington, DC 2000.

dispatch of their plant outputs on a daily or hourly basis-- a situation which is not likely to happen in South Asia for quite sometime in the future.

- The establishment of the Central Electricity Regulatory Commission (CERC) and the impending introduction of availability and frequency based tariffs. Over the longer term this will force more realistic appraisals of the value of peaking power by SEBs (and their unbundled successors as reform proceeds in India), making it easier for hydro projects to realize their economic peaking value.
- The creation of the regional load dispatch centers operated by Powergrid at the Power Trading Corporation, established in the first instance as a vehicle for long-term marketing of power from Indian thermal mega-projects, but which will facilitate opportunistic short-term power trading as well. In addition, if successful PTC will also benefit inter-regional transfers of hydro peaking energy. (A simplified version of the framework for electricity trading in India is summarized in Annex 5.)<sup>20</sup>
- The increasing integration of the regional grids through additional inter-tie capacity. Several high voltage direct current (HVDC) back-to-back links between and among the four regions are in various stages of development. In the Indian Tenth Plan period (2003-2007), it is planned that the Northern and Eastern regions would be synchronized (as would the Southern and Western regions), with full integration during the Eleventh Plan (2008-2012).<sup>21</sup>
- Progress in Electricity Board reform. Orissa, Haryana and AP have all taken significant steps toward reform over the past two years, and these states may well be joined by several more in the next few years, for example, UP, Rajasthan and Karnataka. Reform is fundamental to restoring creditworthiness, without which hydro-export IPPs in Nepal cannot reach financial closure.

60. These developments will of course also benefit Indian hydro schemes that are potential competitors to Nepalese export projects. Indeed the failure of India to make much progress in realizing its hydro potential is less a matter of lack of projects but of institutional and financial constraints that have prevented Indian IPP hydro projects from reaching financial closure, and have delayed public-sector projects. Nonetheless, a healthy and financially viable Indian power sector would also benefit Nepal. Nepal's comparative advantage in hydropower lie not in the cost of developing hydro projects, but mainly in its ability to create an institutional framework that would enable export oriented hydro projects to be implemented more easily than in India. Such projects would be less subject to delays caused by inter-state water disputes and resettlement and rehabilitation (R&R) controversies. As a small country unencumbered by the complex Centre-State relationships that characterize the Indian polity, HMGN has an opportunity to create a policy environment for IPPs that is more favorable than in India. While important steps in this direction have already been taken (such as the establishment of the Electricity Development Centre), additional action is required to strengthen Nepal's potential advantage over India. While Nepal already has one of the best policy frameworks in South Asia for attracting private capital into smaller hydro projects to meet its domestic needs, additional steps need to be taken to strengthen Nepal's comparative advantage over India for the much larger projects suitable for dedicated export.

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20. Annex 5 is an extract from a Project Appraisal Document on a proposed Bank loan to Power Grid Corporation of India.

21. Central Electricity Authority, Fuel Map of India for 9<sup>th</sup>, 10<sup>th</sup>, and 11<sup>th</sup> Plan, New Delhi. August 1998, Section 7 (Core Transmission Plan);

### ***Options for Increasing Power Trade***

61. *Large Storage/Multi-purpose projects:* The Nepalese Ninth Plan states that highest priority is to be given to the development of large projects like Pancheswar, Karnali (Chisapani) and West Seti. However, even if the physical market potential for absorption of mega-projects is present, the prospects for *commercial* absorption of this potential is at least 15 years distant, even under optimistic assumptions about the pace of power sector reform in Indian states. (Annex 6 presents market prospects for power in India under alternative scenarios.) Moreover, private financing of such large projects will be extremely difficult (as evidenced by the worldwide trends).<sup>22</sup>

62. *Incremental expansion of present arrangements:* Given the present financial condition of the two State Electricity Boards immediately adjacent to Nepal—Bihar and Uttar Pradesh State Electricity Boards (BSEB and UPSEB)—expansion of exports to these two states, beyond the presently planned 150 MW, would involve unacceptable risk to Nepal. In order to benefit from the wider Indian market until such time as grid synchronization becomes feasible, the option of an asynchronous link into the POWERGRID's transmission network should be considered.<sup>23</sup>

63. *Medium-Small Sized dedicated export projects:* We believe that the best prospects for increasing hydro exports over the medium term are smaller dedicated export projects in the 200-300 MW size range, whose output can be absorbed by a creditworthy buyer. Even so, such projects would still be difficult to implement. Even under ideal conditions, hydro projects are more difficult to implement as IPPs than thermal projects. However, their prospects are materially better than those for mega-hydroprojects.

64. We believe that Haryana—the first reforming State in the Northern Region and Uttar Pradesh—represents such a potential market opportunity. We expect that “underdesigning” a run-of-river project (such as Upper Karnali) is likely to be more bankable than a traditionally optimized storage hydro project (for example, the Snowy Mountain Engineering Company [SMEC] redesign of West Seti), not least because run-of-river projects involve minimal litigation and schedule risks consequent to environmental and R&R issues. Moreover, the worldwide experience with hydro IPPs clearly shows greater success with smaller run-of-river projects (as illustrated in the background report on power trade in the case of projects in Laos serving Thailand).

### ***Economic Benefits of Power Trade***

65. *Macroeconomic impacts:* Caution is warranted in evaluating the estimates of potential revenue from export projects. For example, the estimates of SMEC and Asian Development Bank (ADB) in the case of West Seti are in excess of \$350 million (properly discounted at 12 percent in constant \$). This is much less than the developer's undiscounted estimate of excess of \$1.5 billion and has raised unrealistic expectations. Certainly such levels of revenue would raise a number of macroeconomic issues.

66. However, at the more probable levels of revenue from smaller projects such as Upper Karnali, macroeconomic issues would unlikely arise. For example, under an avoided cost tariff (resulting in an internal rate of return [IRR] of 21 percent for the developer), the value to HMGN is \$53.5 million (in present value terms), with first year (2007) flows of around \$15 million. Under a cost-of-service PPA

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22. Recent World Bank study shows that of 239 privately financed projects that reached financial closure in 1994-1996, hydro accounted for only seven percent by capacity. If one excludes the 2400 MW Bakun project in Malaysia, which was heavily supported by the Government and subsequently postponed, other surveys suggest that hydro accounted for only 2.5 percent of capacity. Most importantly, many of the successful hydro IPPs have been run-of-river, with few storage projects and even fewer multi-purpose projects.

23. This option was studied in the Masterplan, which concluded that it would be economically optimal only once larger hydro projects (such as Upper Karnali) were completed. However, we believe it is worth examining the option of accelerating completion of this link in order to benefit from low-cost thermal imports from India.

based on the GoI tariff norms (and a 15.8 percent IRR), the revenue take of HMGN is reduced to \$46 million.

67. In 2005, NEA hydro exports would earn some \$38 million/year, while the first year's revenue to HMGN from the Upper Karnali project would be \$13-15 million. This totals less than 10 percent of the projected 2005 merchandise export earnings of US\$580 million.<sup>24</sup>

68. *Carbon credits under the Kyoto protocol:* To the extent that Nepalese hydropower displaces fossil-fueled generation in India, additional benefits may accrue from carbon offsets. For example, a 300 MW hydro project generating 2100 GWh in an average hydro year (based on e.g., 300 MW Upper Karnali export project) could conceivably displace roughly 2.1 million tons of CO<sub>2</sub> per year. At a carbon offset value of \$20/ton (or \$5.45/ton of CO<sub>2</sub>), this amounts to an offset value of roughly \$11.5 million.<sup>25</sup> However, there remains large uncertainty about the precise modalities of fiscal transfers; the monetary value of the offset; and, most importantly, how lenders would factor offset payments into project cashflows. It is not likely that an otherwise uneconomic hydro project would become viable solely as a consequence of carbon offsets, given the uncertainties about changes in offset market values. Nor is it clear how offset benefits would be allocated between buyer and seller in the case of export projects.

### **Action Plan**

69. In order to implement this hydropower export strategy, HMGN should consider taking several immediate actions, as follows:

- The incremental expansion of exports to neighboring areas in Bihar and UP requires some urgent action to put in place the required transmission capacity. However, the Power Exchange Committee which has been assigned the task of coordinating this expansion of transmission capacity from the present 50 MW to 150 MW, does not function well. Meetings are subject to many postponements and cancellations, and a technical subcommittee established in June 1998 to consider the technical issues associated with increasing the transmission has suffered severe delays. Part of the problem is that the Power Trade Agreement is still before Nepal's Parliament awaiting ratification. HMGN may wish to seek ratification of the Agreement soon.
- The Masterplan needs to be updated to reflect recent developments in India. For example, the Masterplan export promotion scenario assumes that the 200 MW asynchronous link would be used only for exports. Yet with the Eastern region of India likely to be in surplus for some time, importing relatively low-cost thermal power from NTPC (or even wheeled from private companies who find themselves with surplus, such as presently faced by CESC), would have significant advantage to Nepal. There is no reason why the asynchronous link could not be used for thermal imports as well as exports.
- Present plans to expand the level of power exports from 50 MW to 150 MW may well represent an upper limit to the power that can be exported to neighboring border areas without grid synchronization (or dedicated export projects synchronized to the Indian grid, unconnected to the NEA system). A detailed engineering study needs to be undertaken to quantify the costs, benefits, and optimal timing of asynchronous links and grid integration. Such a study needs to

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24. As projected in the World Bank CAS.

25. The estimate assumes that Nepal hydro exports would displace a mix of older coal fired plants and liquid fuel thermal peaking for which estimates indicate system wide CO<sub>2</sub> emissions value of 1 kg CO<sub>2</sub>/kwh. Estimates are drawn from the Bihar and Andhra Pradesh case studies carried out in connection with the India: Environmental issues in the Power Sector Study (ESMAP report #205/98, June 1998).

consider recent development in intertie technology (including the “HVDC-light” technology, which Nepal may be able to access under bilateral aid from Sweden).

- Efforts should be undertaken to identify daily peaking run-of-river sites in the 200-300 MW size range for potential IPP development as dedicated export projects. As indicated above, this is of a size range that could be marketed more easily in Indian reforming states; could be more readily financed (given the increasing resistance of financing sources to becoming involved in controversial hydro projects); and could serve as a confidence building step before embarking on larger projects that may be seen by private lenders as more risky.
- Efforts to continue with the development of larger storage hydro and multi-purpose projects should continue, but an important step should be to explore new models of public-private partnerships to address the difficulties of attracting private financing into such projects.<sup>26</sup> These options are not unrelated to institution reforms in the sector, requiring at a minimum an unbundled hydro-generation company mandated to run on commercial lines, initially government owned, but established in a form suitable for raising private capital through joint ventures and/or special purpose project companies.

## VII. Rural Access to Electricity

70. In Nepal, the access to electricity and to commercial energy sources in general, in the rural areas is very low (about 5 percent of the rural population has access to electricity). This is partly a consequence of the rugged terrain in the country; but clearly providing greater access to electricity for many population groups in the country could be improved. The strong links between rural electricity and poverty reduction underscore the importance of improving electricity access to rural communities (Box 1).

71. The lack of access to commercial energy forces rural consumers (comprising over 88 percent of the population in Nepal in 1996) to rely on traditional fuels—mainly fuelwood, agriculture waste and animal dung—for cooking and lighting needs. Of the total residential energy consumption in rural areas, traditional fuels in 1995/96 accounted for over 98 percent of consumption (in urban areas the share of traditional fuels was just under 77 percent). The remaining two percent of energy needs in rural areas is met by commercial fuels, of which kerosene use dominates the energy mix (83 percent), followed by biogas (11.4 percent) and grid electricity (5.6 percent).

72. The heavy reliance on traditional fuels poses serious threats to the health of rural populations, especially women and children who are most exposed to indoor pollution (see Box 2).

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26. Given similar problems in India, the Government has begun to explore alternative models for attracting private capital, including joint ventures between National Hydro Power Corporation and private parties, and variants of the Brazilian experience involving private refinancing during construction.



### **Box 1: Electricity and the Poor**

There is sufficient evidence on the positive impact access to electricity has on the lives of the poor. Studies in other countries have emphasized that having electricity is beneficial for children's education because it facilitates reading during the evening and in the early morning hours. In addition, adults also tend to read more when their household has electricity, and this is especially true for women.

Electricity also leads to the availability of greater communication in the form of radio and television. Even in a poor country such as India, the use of black and white televisions in rural areas has significantly increased during the last ten years. In this way, people in rural areas have access to knowledge and information that otherwise would not be available. Although there is not much research on the relations between electricity and communications, electricity obviously is also necessary for communities to have any type of communication systems.

Depending on the conditions in local communities, electricity also can lead to increases in rural productivity as a complimentary program to rural development. The most immediate impact of electricity on local enterprises is that grain mills switch from human and diesel energy to electricity. Electricity often can lead artisans to work more in the evenings. Small businesses such as retail shops also depend on electricity for lighting and refrigeration. Electricity programs often compliment health programs by providing refrigeration for medical supplies. For productive uses, as indicated in an example from Peru, it is the case that programs involving complimentary social infrastructure have a greater impact than any one type of infrastructure on its own.

### **Box 2: Biomass Fuels and Health**

Studies on the health effect of smoke from the use of biomass fuels in rural areas found that indoor levels of particulate matter regularly exceed, by several orders of magnitude, the safe levels cited in World Health Organization (WHO) guidelines. WHO's guidelines recommend that a concentration of 23 micrograms per cubic meter should not be surpassed more than seven days per year. Studies in Nepal show that during cooking, this concentration was actually between 9 and 38 times higher. A similar study in India showed that during cooking with wood, the actual concentration was (for 15 minutes) 75 times higher than WHO's limit. When using dung, this estimate was 90 times higher.

Carbon monoxide emissions resulting from indoor burning of biomass fuels may give rise to ambient concentrations that interfere with the body's normal absorption of oxygen. Estimates indicate that smoke contributes to acute respiratory infections that kill some 4 million infants and children per year. Recurrent episodes of such infections show up in adults as chronic bronchitis and emphysema, which can eventually lead to heart failure. Studies in Nepal and India of nonsmoking women who are exposed to biomass smoke found abnormally high levels of chronic respiratory disease, with mortality from this condition occurring at far earlier ages than in other populations; rates were comparable to those of male heavy smokers.

### ***The Challenge***

73. The main challenge therefore, is to provide sustainable and affordable access to energy in the rural areas. The importance of meeting this challenge is articulated in the Ninth Plan, which documents HMGN's desire to improve the provision of electricity services to rural areas. While the provision of a full range of energy services (including access to petroleum products, together with improved cooking stoves with a chimney) should constitute the nation's rural energy policy, the focus of discussions below is on rural electrification only.

74. At present, except for initiatives such as those by the Butwal Power Company (BPT), rural electrification is the sole responsibility of NEA. The BPT is the only other non-NEA agency that has so far implemented grid-connected rural electrification.<sup>27</sup> The resources required to continue and accelerate rural electrification efforts exceed the capabilities of NEA. Furthermore, it is unclear whether NEA is the most suitable institution to undertake rural electrification.<sup>28</sup> Clearly, therefore, this is one area that warrants the active participation of the private sector as well as the public sector.

75. In Nepal, the private sector has indeed met with some success in implementing rural electrification projects. There is also evidence that the private sector in Nepal has continuing interest in undertaking rural electrification projects. What is needed to implement such projects is the existence of an enabling environment that promotes private sector involvement in rural electrification. This includes the establishment of distribution networks based on the national grid and mini grids, based in particular on hydro schemes. The enabling environment also includes the creation of clear policies and regulations pertaining to private sector involvement in rural electrification projects. At present, all projects dealing with energy address the need for creating the right environment that encourages private participation (such as the DANIDA project, planned ADB and World Bank projects, and the planned GTZ project). A number of national and international NGO's and private investors are also working to achieve the same objective.<sup>29</sup>

### ***Options for Improving Rural Access***

76. Options for increasing the electrification rate in rural areas include the following.

- grid extension
- mini grids based on micro, small and medium hydro
- mini grids based on diesel; and Photo Voltaics
- battery charging stations connected to the grid or any of the above mini grids
- solar home systems
- wind and biogas

77. The discussions below are focused on the grid extension and the mini-grid options based on hydro. Other options—although improving rural electrification—are either costly or unrealistic for different

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27. The Butwal Power Company Ltd. (BPC) is a non-profit organization established by the United Mission of Nepal (UMIN).

28. BPC has been able to deliver rural electrification in Nepal at much lower prices than the NEA. For example, investment costs per household were in the order of US\$150 (considerably below the worldwide average of US\$600 per connection). The BPC cost however is not the true cost since much critical input, especially foreign expertise and technical know-how, are provided free of charge or at much reduced cost. For example, engineering fees, contractors' overhead and profit or risk margins are not charged to BPC projects. The cost only reflects pure material and labor charges and excludes the cost of project identification, community relations and user motivation which significantly contributed to the success of the projects.

29. That privatization of distribution does not impede rural electrification is supported by the recent experience in the Indian State of Orissa, where the operators of the newly privatized distribution companies have started a number of new initiatives to improve access and quality of service in rural service areas.

reasons; or their impact is likely to be relatively marginal although under circumstances some of these options would prove to be attractive (Box 3). For example, Photo Voltaics is significantly more expensive compared to the alternatives; while off-grid diesel is the least cost option, its short supply (diesel is imported from India) and issues related with its transportation into the hilly areas limit the extent of its use (Table 6). Although there appears to be some potential for wind technology,<sup>30</sup> it is unlikely that wind could provide a significant contribution at-least in the near future. Furthermore, the expansion of the biogas program can provide additional choices and access for rural people to sustainable and clean energy sources for cooking and lighting while reducing the burden on fuel-wood.<sup>31</sup> Based on the success achieved so far, it is anticipated that the target set by the Ninth Plan (install another 90,000 unit) is likely to be achieved. However, there is a concern that subsidies provided for biogas development may not benefit the poorest, since they would be unable to obtain a bank loan for installation, furthering economic inequality in rural areas.

**Table 6: Cost Comparisons of Rural Electrification Project**

Type of RE	Capital Cost \$/kW	Capital Cost \$/Customer	Average Cost \$/kWh
Integrated Grid	3,000	200+350=550	0.15
Off-Grid Mini-Hydro	8,000	3,750	1.17
Off-Grid Diesel	1,000	-	0.20-0.40
Photovoltaic	11,000	\$550 for 50 W	1.00-2.00

*Source: Asian Development Bank*

30. Studies carried out by the United Nations Development Program (UNDP) show a potential of roughly 200MW just along the 12 km valley between Kagbeni and Chusang in the Mustang district

31. Up to mid 1998 a total of 49,275 biogas plants have been established in 61 districts in Nepal. More than 90 percent of the biogas plants installed are in operation. During the Ninth Plan, the installation of another 90,000 biogas plants are foreseen. The total market is estimated at 650,000 units of which 62 percent lie in the terai, 37 percent in the hills and one percent in the mountains. The Biogas Support Program (BSP) which has supported the implementation of the biogas plants has now entered its third phase, which runs until 2003. A consortium of three parties--KFW, HMG, and SNV--provide subsidies for the installation of biogas plants. The subsidy that amounted to about NRs 137 million for 1998/99 are provided through the Agriculture Development Bank of Nepal (ADB/N).

### Box 3: Alternative options and their Viability

There is no single technology that would best suit all possible applications and rural settings and only a mix of different rural energy technologies can respond to the diverse site conditions and customer requirements. The optimal choice of rural energy technology varies depending on factors such as: site and location; distance between the rural load centre and the integrated Nepal power system (INPS); access to road; whether or not the electrification project is a greenfield development with no other experience with electrification in the rural community; expectations about future industrial loads, lighting and entertainment needs; and harmony within the communities etc. For example (based on the report prepared by ENTEC AG):

- Lower-cost grid extension is preferred over mini hydro-based local grids if the distance between the rural load centre and the INPS is less than 32 km with limited road access and if no other attractive mini hydro sites can be found in the vicinity. If a particularly attractive mini hydro site (involving hydro investment of US\$ 2500/kW) is available then the distance between the local centre and the INPS should be less than 23 km in order for the grid extension to become attractive.
- The micro hydro (less than 100kW) is preferred over mini hydro if the electrification project is a greenfield development with no other experience with electrification in the rural community (no small petrol and diesel generators) and if no larger industrial loads (greater than 10 kW) are expected in the first 10 years of the scheme's operation.
- Solar home systems would be preferred if the load consists of lighting and entertainment requiring less than 100 W for a limited number of hours in the evening (pre-electrification) and if the community is likely to run into difficulties when organizing a collective approach to electrification.

78. **Grid Extension:** The extension of the national grid into rural areas seems to be the most cost-effective way to reach a large number of rural people, especially if alternative low cost approaches are adopted. If full cost recovery is required, priority should be given to those areas where the economic and geographic conditions are favorable. These include easy road access; proximity to existing grid; high density of population and income; considerable potential for economic growth; and high demand for productive use of electricity. NEA, communities or private parties can undertake extension of the distribution grid to rural areas. At present, grid extension into rural areas is planned to be addressed by the proposed ADB loan, as well as the proposed Power Development Project.

79. **Mini Grids:** For areas with a high potential for productive use, but far from the national grid, the establishment of mini grids based on hydro is an option. NEA has adopted this approach for the electrification of District Headquarters. However, the mini hydro-based local grids are a relatively expensive option to electrify rural areas in Nepal with an average specific investment cost of about US\$ 8000 kW. One of the main reasons for the high cost is that typically mini hydro development has followed almost exclusively the NEA approach which put heavy reliance on foreign expertise and foreign equipment especially, when grant or loan funding was involved.<sup>32</sup> As a result of the high costs, these mini grids were all operating at a loss, which forced NEA to stop further development and to lease the existing plants to private parties. In 1993, NEA leased five of these plants to private investors who managed to operate them profitably. In 1999, NEA expected to lease another seven hydro plants. All plants leased to the private sector are stand-alone. NEA expects to continue operating the remaining 14 plants either

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32. International experience shows that isolated mini hydro plants for rural electrification can be built at much lower costs than NEA. A typical figure is between US\$ 4000kW to US\$ 6000/kW. Recently, a 35 kilowatt project supported by UNDP's Rural Energy Development Program was completed in Nepal's Tanahu District. The project would electrify about 223 households. The cost of the project is estimated to be roughly RS.3.75 million which translates into US\$ 1530/kW (or US\$ 240 per household).

because there was no interest from private investors or because NEA did not wish to relinquish ownership. Two of the 14 are connected to the grid while the rest are stand-alone. The Government intends to involve the private sector in the remaining 14 projects. To create the required enabling environment, NEA, with assistance from GTZ, formulated a standard power purchase agreement for hydro plants below 1 MW (plants below 1 MW do not require a license anymore). The proposed Nepal Power Development Project will include the creation of a Power Development Fund, which can provide long term loans for hydro development, including hydro plants from 100 kW to 1 MW. For very small communities, micro-hydro (below 100 kW) would be an option. DANIDA's Energy Sector Assistance Program (ESAP) program, which started in March 1999, addresses projects in this range.<sup>33</sup> Crucial for the development of mini hydro (100 kW to 10 MW) is the development of a project pipeline for the PDF. One of the main issues related to mini grids is the ability to pay. Areas close to potential sites where productive use is likely and willingness and ability to pay is higher, are likely to attract interest from private developers.

### *Subsidies – Reaching the Poor*

80. Subsidies are clearly undesirable because of the many distortions they can create; their regressive nature; and the difficulties in removing them once their usefulness is outlived. In some cases, however, subsidies may be necessary to promote rural electrification, the burden of which is borne by other consumers. For example, ADB's Rural Electrification project requires a 0.9 percent overall tariff increase to support rural electrification. Even in developed countries, rural electrification projects receive subsidies in one form or another. In many developing countries, rural electrification projects are supported through subsidies. For example, in Brazil the purchase of wind turbines to generate electricity for rural communities is being subsidized through a Social Development Fund. In other countries, where rural electrification has been relatively successful, access or capital charges have been subsidized rather than operating costs. For subsidies to be effective they must follow some general principals: they have to be transparent, limited, well conceived and managed, and properly targeted. Furthermore, a well-designed exit policy should be in place, which allows for easy removal of the subsidy when it is no longer needed.

81. In designing a subsidy scheme the following important questions must be carefully considered:<sup>34</sup> whom to subsidize? There is ample evidence worldwide that subsidies are often miss-directed. Only a small portion of the subsidies reach the poor for whom they are intended – the rich and the middle-class consumer are the main beneficiaries. If subsidies are meant to improve the welfare of the poor, they must be directed to people who cannot afford access to high-quality energy services. These are typically the very poor living in rural areas. What to subsidize? Rural electricity can be subsidized in a number of ways. For example, subsidies can be applied to access costs (capital costs of connections), or operating costs (ongoing consumption). Evidence from other countries shows that providing a partial subsidy on the cost of connections is more effective than a subsidy on ongoing connections). Capital subsidies on access costs not only reduce the cost of service to the poor, it has also encouraged businesses to increase connections in the rural areas.<sup>35</sup> How to subsidize? Subsidy implementation mechanisms are broadly categorized as demand side subsidies or supply side subsidies. Although, in the context of Nepal further study is needed to establish the right mechanism, in general demand side subsidies work better than the

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33. ESAP is US\$ 20 million program for a period of five years. The Executing Agency is the Alternative Energy Promotion Centre (AEPIC). About US\$ 15 million of the DANIDA grant is expected to be used as investment grants for rural electrification infrastructure including grid extension projects. The remaining US\$5 million is ear-marked for technical assistance (TA), half of which is for micro hydro TA component.

34. Energy Sector Management and Assistance Program (ESMAP). "Energy Services for the World's Poor", Energy and Development Report 2000. World Bank, Washington DC.

35. Chile's Rural Electrification Plan is an example of such a program. Under this program, subsidies are provided to rural communities to subsidize the capital costs of acquiring electricity services. This program encouraged businesses to serve poor areas and reduced the costs of connections to poor consumers.

supply side subsidies. Demand side subsidies involve partial funding of connections, and have better targeting properties and provide greater incentives for expanding coverage and sustaining services. Supply side subsidies, although easier to implement have the disadvantages that they are difficult to target, and often undermine efficient service delivery, and raising costs above what they would otherwise be.

82. While the proper design of the subsidy would improve its effectiveness in reaching the poor, the ultimate success of the subsidy schemes also require setting up effective institutional structures, developing regulations that allow businesses to charge remunerative prices for energy services they provide, mechanisms to offset the tendency of politicians to divert subsidies to political interest groups, and the active involvement of community groups in the design of subsidies.

### ***Establishing User Groups and Promoting Awareness Campaigns***

83. **User Groups:** Establishment of user groups is important for any energy project targeting the rural areas. Involvement of user groups in all stages of the project, including identification, planning, implementation, monitoring and evaluation could, although it is a time and resource intensive process, increase the chances of success. Also, by investing themselves in energy access options, user groups assure that demand meets supply and they can simplify the project by becoming one bulk purchaser instead of a large number of small consumers. This can also reduce project cost.

84. **Awareness campaigns:** The availability of electricity itself does not guarantee that its productive use will automatically take place. In order to promote productive use and thus promote economic development of a rural area, awareness needs to be created on the possible productive uses of electricity and on the markets for the products produced. This awareness component is a crucial element in each rural electrification project. Like the involvement of user groups, awareness campaigns are also resource and time intensive, but the benefit of this effort could also be substantial.

### ***Action Plan***

- Expand the national grid. Because of the difficult terrain and the low level of general electrification in Nepal, this option alone will not solve the problem. In addition, the expansion would require an adherence to the principles of emerging best practices, including financial viability of the national entity involved in developing rural distribution systems.
- Develop community based micro-hydro systems. It would appear that community based micro-hydro systems with small distributions systems are viable in Nepal. Although there are existing institutional model for implementing community based micro-hydro systems, their service efficiency needs to be further enhanced.
- Commercialize the pico-hydro systems to replace and supplement the traditional water power systems. This would also appear to be a possibility for the development of household and household group level electricity service.
- Establish and strengthen user groups. Involve user groups in all stages of the project, including identification, planning, implementation, and monitoring and evaluation.
- Launch awareness campaigns about the possible productive uses of electricity and the markets for the products produced.
- Assess barriers to private entry in rural electrification projects and create an enabling environment that promotes private sector involvement.

Possible institutional means to achieve the above action plan could include the following:

- Setting-up a Rural Electrification Office with the capacity for providing technical assistance support for the development of grid and non-grid electrification projects.
- Establishing rules for off-grid rural electrification, allowing for possible subsidy schemes and for ensuring that the private sector can charge tariffs that allow them to operate a business.
- Assessing the desirability of well-targeted and conceived loan funds, with possible subsidies for capital costs for new connections.
- Developing low cost off-grid extensions.
- Coordinating donor support to maximize efforts to achieve rural electrification, especially off-grid electrification.

## Nepal: HydroPower Development Policy 2056 (Year 2000)- Comments

### *Detailed Technical Comments*

#### **Policies (Section 4)**

Some of the policy objectives need to be clarified (at least as written in the English translation at hand), particularly from the perspective of signals to prospective foreign investors. For example:

*4.9. For supplying the electrical energy at reasonable rates, the electricity tariff fixations process shall be made appropriate and transparent.*

“Appropriate” is a word that gives little comfort to investors, for it can mean almost anything. Since the policy proposes an autonomous regulatory body for fixing (5.8.1(1)), it should be stated up front?

*4.9. Proper arrangements shall be made to cover the risks arising in hydropower projects.*

It is not clear from the statement who would cover the risks? The clause of the Policy (para 5.27) that expressly addresses risk needs to go much further if the concerns about equitable risk allocation are to be resolved to the satisfaction of potential foreign investors (and, at least as important, to private lenders). The clause as written proposes to offset construction risk by extending the period of the production license – which is unrealistic, since additional revenue 30 years hence has no measurable impact on internal rate of return (IRR), the yardstick by which private investors assess a potential project’s attractiveness.<sup>36</sup>

#### **License terms (Section 5.3)**

The license terms proposed in the new policy (30-35) years are significantly different to the old policy (*Hydropower Development Policy-2049*), which previously was 50 years. Whether the term in a BOT project is 30 or 50 years does not greatly influence the internal rate of return to private investors – though there may well be some other consequences (see below, comments to para 5.12)

#### **Licenses (5.3.2)**

The specification of the duration of the production license from the *date of receipt of the production license* would be unusual in international IPP practice. More common is a link to date of construction begin and/or time of commissioning (parallel to the provisions of a typical PPA), with a time-bound interval from the assignment of exclusive rights to a developer to achievement of financial closure. It is unclear what milestones are expected to have been achieved by the developer for a production license to be awarded (signed and bankable PPA? Financial closure?)<sup>37</sup>

Clause 5.2.8 states: *The criteria and evaluation for awarding license shall be made transparent.* Yet the document (in the draft as received) does not enumerate what these criteria are. If the commitment to

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36. See our detailed comments to para 5.27 for further discussion of the risk allocation issue.

37. In international practice it is usual for the PPA to set a mutually agreed-upon schedule of construction, which often contain penalty clauses for delays that are the sole responsibility of the contractor. The license term is typically assumed to commence from the agreed upon date of synchronization.



transparency is to have any meaning (and not be applied on an *ad hoc* basis), then these should be spelled out (and if not in this document, then in a set of implementing regulations). In particular, the criteria for extensions of survey licenses need to be described, and licenses should be made conditional upon the achievement of specific milestones to avoid site banking. (If indeed survey licenses are not renewable, then this should also be made explicit).

#### **Licenses for water storage projects (5.3.4)**

The problem with license terms being dated from time of award of production license is recognized here, with the longer construction times usually associated with storage projects. The policy should, however, make explicit the definition of a “storage project” since even so called run-of-river projects may have significant pondage to allow daily or even weekly peaking operation. Unexpected geological conditions, rather than “storage” *per se*, is the main issue in construction time.

#### **Handover of Electricity production projects (5.12)**

Para 5.12.1 requires private sector projects to be handed over to HMG at the end of the license term (para.5.12.1) without compensation. This makes it unlikely that owners will make significant outlays for maintenance and improvement of equipment in the decade before license expiry.

Para 5.12.2 attempts to address the requirement that “*an arrangement shall be made to supervise and monitor to operate and maintain in good condition the hydropower projects.*” It would be preferable to recognize that it is in HMGN’s longer term interest to provide incentives for IPPs to continue to maintain the value of the facility until the very end of the license term, and that these should *not* be assigned zero value at the time of transfer.

#### **Royalty (5.14)**

Royalty, which is effectively “economic rent” associated with a resource defined as surplus return over and above the value of capital, labor materials and other factors of production employed to exploit the resource.<sup>38</sup> Royalty should accrue to the resource owner and should in a market context be the difference between market price of power and energy and the cost of producing it using the resource in question. The value of royalty should therefore be related to the attractiveness of the resource. Our specific comments on the royalty structure proposed in the report are therefore: it should not be the same for every project; and while some recognition is given to the fact that hydropower project royalties need to be back-ended, the approach seems far too deterministic.

We have not had the opportunity to conduct a full financial analysis of the impact of the proposed changes – which particularly in the case of export projects may have a significant impact. However, a preliminary analysis of review of the proposed provisions reveals the following:

- The capacity royalty (at least as written in the Table) is specified as “*Royalty per kW*” Is this a one time payment, a payment per kW/month (which is the usual definition of capacity-based charges), or per annum? The formula that is added with the intent of providing clarification does not specify the units.
- For an export project of 300MW size, producing on average some 1,900GWh/year (as in the Upper Karnali case study given in the detailed background report), the proposed total rate works out at roughly 12-15 percent of revenue sold for the first 15 years, and 25-35 percent of revenue

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38. For a detailed discussion on this subject see World Bank Discussion Paper in publication “Measuring and Apportioning Rents from Hydro-Electric Power Developments”.

beyond 15 years (depending upon the type of PPA and the tariff escalation clauses it contains). It is worth noting that this is significantly above the typical 10-12 percent “free power,” effectively a water royalty, for which there are precedents in India. Therefore the proposed rates would be a significant impediment to a negotiated PPA subject to the cost-of-service regulation under the GoI tariff norms. Even in the case of a competitively bid hydro project based on least levelised (or avoided) cost to the buyer (e.g. as contemplated by the power procurement guidelines recently issued by the Haryana Regulatory Commission), then Indian IPPs who are subject to only a 10 percent free power requirement (that would have to be paid to the state Government in which such a project is located) have a significant bidding advantage over a Nepalese competitor.

- It is unclear whether clause (c) applies to dedicated export projects. If yes, the clause is onerous and gives entirely the wrong message to potential IPPs. What constitutes a project which is “*more attractive*” is vague and arbitrary, and subject to uncertainties of an undefined negotiation process. This would be particularly an issue for avoided cost-based PPAs.

It is noted that the clause (d) from the earlier draft version of the hydropower Policy (of the 10<sup>th</sup> February 2000 Draft #10) has been dropped (“*Capacity royalty as stated above shall be increased and charged at a rate of five percent every year after the enforcement of the policy*”). However, the formula that is provided in the note does in fact provide for such an escalation:

$$\text{Capacity royalty} = \text{capacity royalty rate} \times (1 + 5/100)^{\text{year} - 2056} \times \text{installed capacity (kW)}$$

We have several concerns:

- Has the escalation been dropped, but the formula inadvertently remained unchanged? Or has the provision in fact been retained, in which case we do not understand deletion of the old para (d).
- In any event, the formula as written does not provide the result intended. The exponent to which  $(1+0.05)$  should be raised in order to provide the result stated in the old para (d) is not  $[\text{year} - 2056]$  but  $[\text{year} - \text{year}(x)]$  where  $\text{year}(x)$  is defined as the year of commissioning (for years 1-15), or year of commissioning+15 (after 15 years).
- In the case of a cost-of-service type PPA that most likely applies to an export project serving India, the escalation clause yields a completely infeasible result. For example, a 300 MW project in its 15<sup>th</sup> year would pay a capacity royalty of  $300.000 \text{ [kW]} \times [3000 \text{ Rs/kW}] \times 69 \text{ Rs/\$US} = \$13 \text{ million}$ . Such a project would sell, say 1900 GWh/year, which if sold for 7.16 cents/kWh brings revenue of \$135 million. The capacity royalty thus accounts for about 10 percent of revenue. If the capacity royalty increases by five percent per year, then in year 40 of operation the capacity royalty is  $\$13 \text{ million} (1.05)^{25} = \$44 \text{ million}$ . However, under the GoI tariff norms, the revenue in year 35 would fall to around \$30 million/year--leading to the infeasible result that the capacity royalty exceeds the sales revenue (or that the sales price would have to more than double in order to pay the royalty).

It appears that a detailed study of the probable impact of these royalty provisions (and related income tax provisions, see below) should be undertaken. This requires that the economics of potential export projects be studied in a detailed financial model, and which includes detailed modeling of the linkages between revenue streams and the terms and conditions of PPAs. Enough is known about the financial structure of such ventures to be able to conduct a realistic assessment without needing access to confidential information held by developers who already hold licenses for Nepalese export projects.

## **Tax (5.16)**

We would urge that the rules proposed in this section apply only to domestic projects pending more detailed study of their impact on export projects. In the case of export projects subject to cost-of-service PPAs (as is likely for all negotiated hydro projects in India), the interaction between the GoI norms and the tax provisions of Section 5.16 are unclear, and require further analysis (based upon a detailed and realistic financial model for a typical export IPP). The reason for this is that under the GoI hydro norms, *income tax payments are a pass through in the tariff*. We believe that the new Indian regulatory commissions, most of whom who have review powers over PPAs, would evaluate a hydro IPP that happens to be located in Nepal by the same tests of prudence and reasonableness as IPPs located in Indian States.

We therefore urge that promulgation of the income tax (and royalty) provisions as would apply to dedicated export IPPs be deferred, pending a detailed study of probably achievable tariffs in India and their impact on developer cashflows and revenue streams to HMGN.

Clause 5.16.1.13. is unclear

*"Income tax shall not be charged on the interest earned on foreign/domestic loan"*

We assume that the intent is to make interest *payments* deductible for purposes of income tax.

## **Export of Electrical Energy (5.18)**

Clause 5.18.1 states *"In view of the abundance of hydropower in the country, incentives shall be provided to export electricity"*

This is not only vague as to what is the precise nature of such incentives, but there is little in the policy that could reasonably be defined as an incentive relative to domestic projects. For example, the rates of royalty for dedicated export projects are substantially higher than for domestic projects. The income tax exemptions are the same for export and domestic projects (10 years from date of commercial production).

Clause 5.18.2 states *"If the electricity produced in the country is to be exported, it shall be done in accordance with the agreement made between HMG and the exporter"*

This should be made more specific. If "the agreement" is the production license, then that should be so stated.

Clause 5.18.3 states that: *For domestic consumption, HMG shall be entitled to buy, if necessary, upto 10% of the production from electricity project specially built for export purposes as per mutual agreement.*

This clause represents a significant constraint to the development of dedicated export projects until such time as the NEA and Indian grids are synchronized. For the foreseeable future, dedicated export projects will be synchronized to the Indian grid, and remain unconnected to the NEA grid. In such a project, to segregate output to supply two unsynchronized grids is technically possible, but entails huge cost penalties (some turbine generator sets would need to be dedicated to the NEA system, isolated electrically, provide separate switchyards, etc). Moreover, in the case of medium size projects with less than 10 turbines, providing 10 percent of the stations output in a separate turbine that is necessarily of different size to the other entails significant cost penalties.

### **Selling rate of Electrical Energy and Tariff fixation arrangements (5.19)**

This clause is not clear. To provide more clarity as to what is the regulatory regime and review requirements for the different types of projects, we recommend that this clause be divided into the following three sections:

- (i) those selling entirely into the domestic system
- (ii) those selling mainly into the domestic system but who may wish to sell part of the output overseas (an option like only one the Nepal grid is synchronized to the Indian grid)
- (iii) those selling entirely for exports.

In the case of (iii), the PPA is between the IPP and the buying entity in India. Indeed, clause 5.19.5 states

*The criteria for the power purchase agreement for buying and selling shall have to be approved by the regulatory body for export of electricity*

This clause raises numerous concerns:

- which “regulatory body” issues approval?
- what is meant by “*the criteria for PPA*”, as opposed to the PPA itself? The type of PPA (e.g. cost-of-service, avoided cost, etc) is likely to be a matter for negotiation (or bidding) between the seller and the *buyer* – which in the case of export projects is not HMG (or NEA).
- Is it intended that HMG reviews the PPA itself? And, if yes, what are the criteria for approval? Is it intended that HMG retains the right to approve the price?

### **Provision of Visa (5.22)**

This issue was discussed at the technical seminar in February 2000, and represents a concern of the foreign parties building hydro-projects in Nepal that HMG is trying to address. However, the proposed language needs clarification, for the intent is unclear:

*“Non-tourist visa and work permit shall be issued to foreign experts, skilled operators and their families on recommendation of One Window Committee upto the period of construction and operation”*

The last clause (“*upto the period of construction and operation*”) is vague and/or redundant, and could imply that visas might not be granted after operation commences – though if so, why refer to skilled operators.

### **To minimize the environmental hazards (5.25)**

This paragraph states: Ten percent of the minimum monthly average flow or the amount mentioned in EIA study, whichever is greater, shall have to be maintained in the river/rivulet.

This clause may not be necessary, for the EIA will address these concerns, as well as the environmental requirements to preserve the riverine ecosystem, in some detail on a case by case basis. It should be sufficient (and in our view *preferable*) to state that the requirements of the EIA mitigation plan for maintaining a minimum flow are a condition of the license.

As written, the definition of minimum monthly average flow is vague, and 10 percent is arbitrary. A distinction should be made between RoR and storage projects. If the intent is to provide a minimum flow requirement between the head works and tail-works, i.e. that portion of the river affected diversion in a

RoR project, then appropriate language should be added to that effect. What happens in a drought year, where the total inflow may be less than 10 percent of the long-term average of the inflows in the minimum month? If in the case of a storage project the intent is to maintain 10 percent of the minimum monthly average flow *at all times* (i.e. 24hour/day 365 days a year) downstream of the tailworks then “*at all time*” or “*continuously*” should be added).

#### Regarding non-electricity benefits (5.26)

para. 5.26.1 states “*If the benefits accruing to Nepal are unutilized and are of substantial benefit to lower riparian country, then dialogues shall be initiated to share such benefit. The license for such project shall be awarded as per this policy*”

para. 5.26.2 states “*The licensee shall have to provide necessary help to HMG to receive such non-electricity benefits*”

The importance that HMGN attaches to the recovery of downstream benefits (DSBs) is clearly recognized. However, recovery of downstream benefits is a matter for bilateral discussion and resolution at the highest government level, and should not involve private parties. These issues need to be resolved and clarified *before* licenses are awarded, for international IPPs will likely be reluctant to assume *obligations* in this area (though they would assist HMGN on a voluntary basis).

#### Regarding Risk (5.27)

*This is a new clause added since the February 2000 Draft. It reads “During construction, if the geological and hydrological conditions at the time of awarding the production license of hydropower project turns out to be reversed or there is force majeure, then arrangements could be made to compensate or offset the effects of additional costs by extending the production license for a maximum of 5 years”.*

We have several concerns:

- Extending the production license for even five years (from 30 to 35 years) has almost no impact on a private developer’s internal rate of return (IRR), the yardstick by which the attractiveness of investment is measured. The proposition that extending the license term amounts to monetary compensation for accepting construction risk is unrealistic.
- The meaning of “reversed” is not clear.
- Presumably the reference to *force majeure* is to signal that PPAs would embody the principle of license extension as compensation for *force majeure* events. This is very unlikely to be acceptable to both private investors and their lenders.
- The reference to hydrology in this section is not clear. If there have been significant changes to the inflow regime then these would very unlikely become apparent during a 2-3 year construction period; even two successive years of low flows do not necessarily signal a long term trend. Therefore the more fundamental issue is the allocation of hydrology risk, something which is not an issue likely to be encountered “*during construction*”<sup>39</sup>

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39. For example, the hydro tariff norms of the Government of India stipulate that hydrology risk is assumed by the buyer for the first seven years of operation, and by the IPP starting in the eighth year. This is sensitive to concerns of lenders that adequate debt service coverage is maintained during the early years of a project when debt service payments are at their highest.

**Annex 1**

These issues of risk allocation may not be serious impediments to smaller private sector projects. However, they become increasingly important as the size of project increases, and whose satisfactory resolution are central to achieving financial closure for projects above 100MW in size.

## Existing Institutional Arrangements

The Ministry for Water Resources is the line Ministry with primary jurisdiction over the power sector – a principal non-consumptive user – which is rightly regarded as having the greatest potential to harness water resources and transform it into economic wealth. This challenge and recognition have led HMGN to establish the current institutional arrangements at four levels – policy, operational, implementation, and regulation.

Policy Level Institutions: There are six institutions that play key roles in guiding HMGN's policy for water resource management – Ministry of Water Resources, National Development Council, National Planning Commission, Environment Protection Council, Water Resources Council, and the Water and Energy Commission. These institutions are responsible for formulating policy and strategic planning for water resource management and water rights.

Regulatory Level: The Tariff Fixation Commission and Service Charge Fixation Committee are the two regulatory agencies that regulate tariffs and service quality for electricity and water, respectively.

Operational Level Institutions: There are four institutions—Nepal Electricity Authority, Nepal Water Supply Commission, Department of Irrigation, Department of Water Supply and Sewerage—which are tasked by HMGN to operationalize water resource policy, and transform water resources into economic goods.

Implementation Level: The District Development Committee, Department of Irrigation, District Water Supply Office, Electricity Development Centre, and Village Development Committee are five institutions that are responsible for implementing HMGN's water resource policies.

In order to bring coordination to energy sector planning and to ensure that sectoral policies are consistent with the Government's broader development and investment policies, HMGN has established a number of Councils and Commissions. The Commissions with jurisdiction in energy sector matters and the power sector include the National Development Council; Water Resources Council; Environment Protection Council; National Planning Commission; Water and Energy Commission; and Tariff Fixation Commission. The Councils are an integral part of the Government itself and play a role in establishing consensus on major policies and strategies which influence power sector development. Policy advice arising from such Councils is now embodied in legislation. The Environment Protection Council and the Water Resources Development Council are new bodies. The Environment Protection Council is expected to provide authority for environment regulation, set standards and provide enforcement of measures to which project design and construction and operation activities will have to subscribe. Among the institutions that directly impact upon the power sector, the National Planning Commission plays a key role in public sector review (i.e., review of NEA) and the Water and Energy Commission plays a key role in policy and planning.

## Profile of Power Sector Institutions in Nepal

Institution	Role in the Power Sector
<b><i>Policy Level Institutions</i></b>	
Ministry of Water Resources	Line ministry responsible for power sector policy, water resource development, oversight of NEA and regulatory agency, and private power development.
National Development Council	Creates policy directives to the National Planning Commission for the development of annual national plans. Chaired by the Prime Minister with broad parliamentary membership.
National Planning Commission	Secretariat to the National Planning Commission for coordination and development of HMGN's 5-year multi-sectoral investment programs.
Water and Energy Commission	Provides policy advice to HMGN on technical, legal, environmental, financial, and institutional matters related to water resource planning and development.
Water Resources Development Council	Advisory group constituted to provide guidance to HMGN on strategic issues and policy regarding integrated water resource development.
Environment Protection Council	Responsible for policy development and preparation of environmental regulations; guidelines for Environmental Assessments; permitting, licensing, inspection, and monitoring of environmental licenses.
<b><i>Regulatory Level Institution</i></b>	
Tariff Fixation Commission	A quasi-independent regulatory agency set up to review and approve tariff filings by NEA. It is neither required to review IPP transactions nor approve power purchase agreements between IPPs and NEA. Also, it is not required to review energy exchange arrangements between NEA and India.
<b><i>Operational Level Institutions</i></b>	
Nepal Electricity Authority	A public corporation responsible for electricity generation, transmission, and distribution throughout Nepal; responsible for energy exchanges with India; single buyer of electricity from private independent power producers.
<b><i>Implementation Level Institution</i></b>	
Electricity Development Centre (recently renamed the Department for Electricity Development)	A Government owned entity responsible for implementation and promotion of the Government's private power policy; manages HMGN's competitive bidding process for IPPs in small and medium size hydropower projects; functions as a "one-stop shop" for private investors in small and medium size hydropower projects; issues survey licenses; guides private investors through the maze of securing permits and licenses; and provides technical support to the Tariff Fixation Commission.



## **The Inefficiencies of the NEA System**

While some initial steps toward reform have already been taken, many problems still remain. These are summarized as follows:

- Although a corporate entity, NEA today is firmly under the control of HMGN. NEA's autonomy is often compromised and its operational efficiency is affected. NEA's organization has gone through a series of changes, mainly increasing the number of managers; however, no changes have been directed to the transformation of the characteristics of the sector envisioned in the Electricity Act and the Ninth Plan. NEA continues to be bound by government procedures, and lacks the flexibility to make operational decisions without lengthy consultation.
- Electricity supply is unreliable because of insufficient capacity for peak load requirements and bottlenecks in the transmission and distribution system. To improve the quality of service to the consumer at the distribution end, decentralization of decision-making and reorientation of the institutional culture, to emphasize customer service, are required.
- The Load Dispatch Center of NEA currently has rudimentary equipment; lacks tools for efficient economic dispatch; and lacks dependable communications. This may lead to inefficient operational planning and inefficient use of available energy resources. Today, load following is done only with a frequency measurement, although financial assistance is in place from KfW to implement a Supervisory Control and Data Acquisition (SCADA) system. As the number of IPPs multiply, the current standard operation practices of the load dispatch centre will need to be revised to avoid creating conflicts.
- The system operation is based on simple rules, which include load shedding as a routine procedure. The load dispatch centre does not feel the need for any additional tools because it considers the planning and operation of their hydro system to be "simple".
- There is only one hydro plant (Kulekhani) with reservoir capacity to compensate for the seasonality of energy available in ROR plants. Generation scheduling is done on a year ahead basis for forecasted demand conditions. Plant operation decisions related to the immediate use of stored water in Kulekhani I&II need to be measured against the corresponding fuel costs of thermal power plants.
- Technical and non-technical losses are around 30 percent, and in some areas as high as 50 percent. Experience in other parts of the world, including India where the institutional culture of State Electricity Boards is similar to that found in Nepal, shows that privatization of distribution is the only model likely to produce a consistent and enduring reduction of non-technical losses, by changing the system to reward improved performance by financial incentive.
- When NEA participates in a project as a joint venture partner, because NEA is both the buyer and the seller, conflicts of interest appear in the negotiation of the PPA contract. The price and conditions of these contracts will affect future consumer's tariffs.
- NEA's responsibility as system planner, as well as generator, gives little transparency to the plants selected by the least cost generation plan.
- NEA's financial position is weak because of poor operational efficiency, restrictions in tariff increases, problems in bill collection, and the need to recover its high costs.

## Chronology of Power Sector Reform in Selected Countries/States

In the last two decades, regulation of electricity sectors has experienced a significant transformation, based on deregulation and competition. The important discovery was that opening the sector to new entries and competition, and at same time defining market rules and marginal pricing, could lead to efficiency gains and more reasonable and competitive tariffs. This opening of the electricity sector was based on unbundling into the different activities; defining specific regulations for each activity; and creating adequate incentives for efficiency.

Initially, this theory and new ideas met with resistance and doubts about its applicability to an industry such as electricity. Concern also existed that competition would not be possible, and the new regulation would lead to abuses and price increases. The experiences of the first countries that adopted the new regulation were, even if not perfect, surprising in proving that private companies were willing to invest and take a share of market risks as long as the new structure also allowed them to take a share of opportunity benefits. Development of flexible commercial arrangements and improvements in efficiency (new dynamics and new ideas that the regulation introduced into the sector) were surprising.,

As experiences multiplied in the world, important lessons can be learned:

- There is no magic restructuring formula to improve efficiency and promote private investment, but basic economic principles have been shared. A specific design has to be created and adapted to the system where it will be implemented and the objectives for the transformation will produce the desired results.
- The principal goal must be to improve quantitative and qualitative efficiency and for the benefits of these improvements to pass through to tariffs.
- Even if unbundling is one of the principal ingredients, it is not in itself an objective; it is rather a means to achieve an aim. Vertical (per activity) and horizontal (diversification within one activity) unbundling has to be tailored to the needs of the system and objectives. The benefits of unbundling are measured in specialization and competition (even competition by comparison).
- Hydro generation can be financially viable in the new structure if the adequate commercial arrangements are designed. Different approaches have been used in countries where hydro regulation is important for the electricity system (e.g. Brazil and Panama have chosen different roads), but the goal is the same: the centralized programming of hydro storage for the benefit of the system as a whole and to guarantee it cannot exercise market power.

At this stage, many different options have been carried in the world, and the pros and the cons of each case can be analyzed. It is seen that restructuring can be done with efficiency gains in both small and large markets; in mature systems as well as in developing systems that need important investments in electrification and transmission expansion; and in thermal systems as well as in systems with important hydro generation. Below, we briefly describe the restructuring characteristics of power utilities in India (Haryana), Sri Lanka, New Zealand, and Central America.

### **The Indian Model: Restructuring in Haryana**

In mid 1990s, the Government of Haryana (GoH) realized that the position of the Haryana State Electricity Board (HSEB) was unsustainable. Lack of investment, increasing power shortages, deteriorating creditworthiness, and high subsidies to agricultural consumers were causing increasing financial stress, with ever-increasing burdens on GoH to provide subsidies. Discussions on the specifics

of reform started with the World Bank in 1996; by early 1997 the Government issued a Policy Statement that outlined the main elements of the proposed reform program. The necessary legislation was enacted in August 1997.

Unbundling of HSEB occurred in two stages. In August 1998, HSEB split into HVPN (Transmission and distribution) and Haryana Power Generation company. After considerable study of the various options for unbundling distribution, the two distribution companies (Northern and Southern) split from HVPN in early 1999. The plan is to bring private capital into these distribution companies through the creation of joint ventures.

In addition to unbundling, one of the key provisions was for the establishment of an independent Haryana Energy Regulatory Commission (HERC); this became effective in August 1998 by the appointment of its Commissioners. The first revenue filing by HVPN occurred in March 1999, and the first public hearings on the revenue filing were held in October 1999.

In early 1998, a loan agreement with the World Bank was signed (a so-called adaptable program loan, APL) which provided the funds for an emergency rehabilitation program to rehabilitate the 50 worst feeders in Haryana. In mid 1999, there was a change in Government, which temporarily put the reform program on hold.

#### **Sri Lanka Electricity Company Pvt (LTD)**

The Ceylon Electricity Board (CEB) is the vertically integrated government-owned utility of Sri Lanka, which has many similarities to NEA. Sri Lanka also has a mainly hydro system but in wake of the severe macro-economic dislocations due to the impact of the drought in 1996, over the next few years almost 300 MW of thermal generation, most of it IPP, will have been added. The Government has also now decided to reform CEB, and is in the process of appointing consultants to study options for unbundling (with ADB and World Bank support).

However, Sri Lanka has already demonstrated the merits of unbundling. In 1984, it was decided that a new distribution company would be set up to take over a number of distribution companies in the greater Colombo and southern regions, owned and operated by municipalities. These distribution companies were highly inefficient with T&D losses in excess of 45 percent and suffered from significant physical deterioration due to lack of investment. The Lanka Electricity Company Pvt (Ltd) (LECO) was set up as an independent distribution company, purchasing power from CEB at 11 kV. LECO was mandated to run on commercial lines with a view to eventual privatization. The Chairman of LECO was given a free hand to organize an efficient and accountable management structure, including the establishment of profit centres for each distribution area. Several senior management positions were filled by Sri Lankans returning from overseas.

With ADB assistance, LECO rebuilt much of the local distribution system and immediately implemented a system to reduce non-technical losses, accompanied by a program to improve customer mix. Despite a number of problems (including widespread civil disturbances during the JVP rebellion of the late 1980s), by the late 1990s its T&D loss rate was 10 percent and it is on track to reach 8 percent loss rate by 2001/2002.

Despite the improvements in technical and operational efficiency, LECO has had financial problems due to difficulties in setting equitable bulk tariffs and has a poor customer mix (most HT industrial customers remain customers of CEB). This underscores the need for an independent regulatory commission to set equitable bulk tariffs as well as consumer tariffs; this problem will be addressed in the forthcoming reform and restructuring program.

### **Power sector reform in New Zealand**

Regulatory reform in the New Zealand electricity industry commenced in mid 1980s. Prior to the start of the reform process, all production, transmission and pricing was done by a single government department. In 1987, this government department was corporatized as a state owned enterprise (SOE) and was renamed the Electricity Corporation of New Zealand (ECNZ). At this time retail distribution was handled by 55 distribution bodies known as 'power boards' and 'municipal electricity departments' owned by elected local government authorities such as city councils. These bodies held exclusive franchises for distinct districts or cities. In 1993, these bodies were corporatized and privatized, although many remained owned by trusts with consumers as the beneficiaries.

In 1992, New Zealand suffered a severe drought and a power crisis. As a result, the Government appointed a committee of enquiry, and it concluded that the correct economic signals would be derived only from a competitive market. In 1993, the industry established the Electricity Market Company (EMCO) – now renamed The Marketplace Company Ltd (M-co) – to facilitate the development of a market for trading electricity.

In 1994, the national grid was separated from ECNZ and was named Transpower, a new SOE. In 1995/96, approximately one-third of the generation capacity of ECNZ was split off and a separate SOE, named Contact Energy, was created to allow competition in generation. In 1995, the pricing functions were moved from ECNZ to EMCO. From 1996, private investors (IPPs) entered the generation market. On October 1, 1996, full open competitive market operations began.

In 1998, the Government announced further deregulation would take effect from April 1, 1999: Contact Energy was privatized with Edison Mission, buying 40 percent from the New Zealand Government and the other 60 percent being floated on the Stock Exchange by way of a widely distributed IPO. ECNZ was further split into three generation companies, each of which remains an SOE but with separate management and the ability to compete against each other and other generators. The local retail/distribution companies were forced to make a choice to become either a distribution (lines operator) or energy retailer. Most chose to remain as line operators and sold their retail business to the generation companies or other specialist retailers. Mechanism for full retail competition was established.

In April 1999, M-co was sold to a private sector owner (RMB Group) and is now operated independent of industry participants.

### **Power Sector Reform in Central America**

Until today, all countries, excluding Costa Rica, have initiated a restructuring process. Honduras is still in the initial stages of design, while Nicaragua is in the last steps of design and is preparing to start implementation. The common characteristics of these processes are: The end of public utilities monopolies; unbundling the activities of the industry and allowing private participation; open access to the transmission grid (including international interconnections) and distribution networks; defining rules to optimize the use of energy resources and promote efficiency; creation of spot markets; and allowing trading between Markets.

Some characteristics of the restructuring carried out in Guatemala, Salvador, Panama and Nicaragua are described below.

# **TRANSMISSION AND SYSTEM AND MARKET OPERATOR (S&MO)**

In all cases, transmission has been unbundled. In some countries, it includes the S&MO, but in others an independent company was created to carry out this role, with involvement of market participants. In those countries, the S&MO is inside the TransCo; an Operation Committee with the representation of Market participants exists.

Country	TransCo	S&MO
Guatemala	Independent State owned	Independent
Salvador	Independent State owned	Independent
Panama	Independent State owned	In TransCo
Nicaragua	Independent State owned	In TransCo

Transmission tariffs were regulated with different methodologies, but all define the economic costs that would be recognized to the TransCo. The costs of the S&MO are paid between all Market Participants.

## **GENERATION AND DISTRIBUTION:**

In all cases, generation and distribution were diversified (horizontal unbundling) and competition was promoted.

Country	Initial structure	New Generation structure	New Distribution structure
Guatemala	Two integrated public utilities. (EEGSA and INDE)  IPPs with PPA contracts with the utilities	One hydro (INDE, State owned)  One thermal privatized (EEGSA)  The IPPs, with the PPA contracts assigned to the new Distribution Companies	Two Distribution Companies (from privatization of EEGSA and INDE)
Salvador	One integrated public utility (CEL)  One IPP with PPA contract with the utility	Projected diversification (one hydro, one geo thermal, one or two thermal), privatization of thermal, still not implemented	Three Distribution Companies, from CEL

Panama	One integrated public utilities (IRHE)  One IPP with PPA contract with the utility	One hydro  One hydro thermal  One thermal  Autogenerators	Three Distribution Companies, from IRHE
Nicaragua	One integrated public utilities (ENEL)  Three IPPs with PPA contracts with the utility	Projected diversification (one hydro, one geo thermal, one thermal), and privatization still not implemented	Two Distribution Companies, from ENEL, still not implemented

Distribution was allowed to own generation up to a certain cap ; in the case of Salvador, there was no restriction.

## **The Framework for Electricity Trading in India**

India is embarking on an evolutionary path towards new approaches in power system operations and trading. The responsibility to facilitate that development and transition falls on POWERGRID. The responsibility to take advantage of the new opportunities falls on each individual utility and generator. The system introduces, through the frequency-linked UI rate, commercial incentives and penalties to promote compliance with regional system requirements, such as compliance with scheduling and dispatch instructions. This is premised on the assumption that the various entities, SEBs and Central Sector Agencies, will honor their obligations – pay their bills and comply with rules for operation of the Regional and inter-regional networks. It is acknowledged that this is not always the current state of affairs. The implementation of bulk power tariff reforms, including the frequency-linked pool rate for unscheduled interchanges, will be a major undertaking and may become controversial, e.g., due to conflicts between participants and/or payment defaults on unscheduled interchanges. Failure to make timely payments for services received is a fundamental problem which must be solved, and the sustainable solution, state power reform, takes time. But difficulties in collecting payments should not constrain development of tariffs which will improve system economics and quality of supply. Any rational system requires the parties to honor their obligations. It is important that the participants commit to themselves and each other that they will embark on a new culture – timely payment of bills and acceptance of merit order and grid discipline principles.

**How is the new Trading System designed to work?** Explained in a highly simplified manner, the system is designed to work as follows:

- (a) Each participating generator (including all central sector plants supplying more than one state and multi-state mega power projects such as CEPA) will indicate daily, for the following day, their capacity and energy availability. On the basis of such declarations, RLDC will advise each participating utility of its capacity and energy availability from the system, with original contracts/entitlements adjusted for the declared availability of generators.
- (b) Each participating utility (SEBs and their grid company successors) will indicate daily, to the RLDC (operated by POWERGRID), for the following day, their power requirements from the regional grid (i.e., over and above what they will generate themselves or purchase locally, e.g., from their dedicated IPPs or captive generators, etc.).
- (c) RLDC will schedule the participating generation (including central sector and multi-state IPPs) for the following day and indicate the schedule for generation to the generators and scheduled drawals of utilities.
- (d) Any utility drawing power would be charged as per the applicable PPAs (and scheduled interchange arrangements, if any), and any generator supplying would be paid as per the applicable PPA, to the amount of scheduled drawals and generation, respectively.
- (e) Any utility and any generator deviating from the schedule would be charged or paid for the deviations at the applicable rate for unscheduled interchange: (1) a utility drawing over the schedule would pay the UI rate. At times of low frequency, this could be as high as Rs 6/kWh; at times of high frequency, this could be as low as zero, i.e., energy would be free. This should discourage overdrawal at times of shortage and encourage use of electricity at times of surplus, in both cases, grid discipline will improve; (2) a generator supplying over

the schedule would be paid the UI rate. (3) any utility drawing below the schedule would be paid at the UI rate, and any generator supplying below the schedule would be charged at the UI rate. Drawing less at a time of shortage would earn as much as Rs 6/kWh while supplying less would cost as much as Rs 6/kWh. This would promote load management and high availability, respectively. Drawing less at a time of surplus would earn nothing and failing to generate up to schedule at a time of surplus would cost nothing.

- (f) Any combination of the constituents of a regional pool could freely enter into long/short term arrangements (scheduled interchanges) on a negotiated basis. Any combination of the constituents of one regional pool, through their respective RLDCs, could also negotiate interchanges with any combination of the constituents of a regional pool in other regions, subject to capability of the interconnections to accommodate such power flows.
- (g) Dispatch would take place at the state-level, by the SLDCs – the concerned SEBs and their grid company successor. Even if the generation plant of vertically integrated SEBs would not have availability-based tariffs, dispatchers would be able to dispatch according to merit order, by comparing the variable cost of the SEB plant; variable cost part of power they purchase from IPPs and NTPC; and the frequency-based pool rate. The various parts of the bulk power tariff and trading reform package are designed to fit together; this is to create a system of commercial incentives (and commercial discipline) to increase the efficiency of utilization of India's scarce generation and transmission resources and to improve reliability and security of supply.

**Options for IPPs:** As discussed above, multi-state IPPs will participate directly in the regional pool. Single-state IPPs have two basic options. They can either remain within the state systems and be dispatched by the SLDC – the concerned SEB or grid company – or they can, with the consent of the SEB/grid company and the RLDC, participate directly in the regional pool. In case they remain with the state system, they can still operate in the regional pool but will have to coordinate with the RLDC through the SLDC. It is expected that over time, state utilities would replicate the regional pool pricing and trading to generators in their systems. Once this happens, the distinction between a state-level IPP and a regional IPP, in terms of pool operations and operational flexibility, would diminish. Being able to directly operate in the regional pool may, however, retain its value as a more effective way to mitigate payment risks and can be expected to quickly become a standard feature in PPAs for major IPP plants in India.

**Application in Inter-regional Trading:** As stated in point (f) above, any combination of the constituents of one regional pool, through their respective RLDCs, can negotiate interchanges with any combination of the constituents of a regional pool in other regions, subject to capability of the interconnections to accommodate such power flows. Even spot arrangements are possible. Whenever the UI-rates of two systems are different, in principle there is scope to reducing the cost of supply until the UI-rates become equal. A proposal has also been formulated to use such cost savings, the difference of the two UI-rates, to finance the fixed costs of interconnections.

**Implementation - will the new Trading System actually work?:** As even the above simplified presentation suggests, the emerging framework for power trading in India provides for numerous trading opportunities and complexities - there should be no concern that the system is restrictive, or in any way limits the potential for trading in India. Actual trading is likely to develop gradually, over time, as participants become more familiar and better equipped to take part in the pool. This is a loose power pool; participation is voluntary, apart from deviations from schedule having to be settled at the UI rate. One SEB can choose to limit its participation to that minimum extent. Another SEB, or its grid company successor, can actively pursue opportunities to reduce the cost of supply with scheduled interchanges and active management of drawals depending on grid conditions. Any generator can choose to just follow the



schedule and be paid as per the PPA or can try to actively seek opportunities to increase revenue by generating more at times of shortage. The RLDCs and the REBs will have to develop rules and adjust them as experience is gained and problems and deficiencies are identified.

**Potential Obstacles to conventional pools in India:** Several countries across the world, in Europe, Latin America, and a few states in the United States, have introduced or are seriously contemplating the introduction of various forms of competitive generation pools, including a pool price set on costs or bids (which may or may not have a relationship to the underlying cost of generation at any given time). In some cases, such as the Nordic power exchange, the majority of power is traded under PPAs and other bilateral arrangements, with only the minority trading on the spot market; while some, such as the England & Wales pool, trade all power through the pool (with extensive use of financial hedging contracts). The introduction of such pool systems in India would be impossible today and will remain difficult for quite some time. There are a number of obstacles to conventional pools in India, which can be broadly summarized into two fundamental factors. Both of these factors will have to be addressed before India or any of its power region can contemplate a move to the more common approaches:

- (a) The required system coordination and control facilities do not exist and will not exist until about 2002-2003 at the earliest. Most SEBs do not have adequate load dispatch and SCADA systems to even operate their own systems efficiently. Regional Energy Management Systems (EMS) and the required communication systems connecting the utilities in real time are similarly non-existent. One of POWERGRID's corporate objectives is to develop such facilities across India. The first is expected to be commissioned in 2002 in the Southern Region, followed by the other regions in rapid succession in the 2002-2003 time-frame (assuming major implementation problems and delays are avoided in these highly complex projects); and
- (b) SEB chief load dispatchers typically have neither the capability nor the authority to trade power or make bids to the pool. Such commercial orientation is lacking and will take time to develop, and will have to be developed in the context of comprehensive state power reform programs and creation of state-level grid companies such as GRIDCO in Orissa.

India can move from the frequency-linked pool price to spot pool prices based on costs or bids, once the facilities are in place and once a minimum level of commercial orientation has been reached. For the latter, India need not wait until all states have restructured their power systems, which might take several decades. That step can be taken on a regional basis. One region can move on to the next stage of power pools once all utility constituents in that region are ready. The Southern and Western Regions may be ready to contemplate such a step in the 2005-2010 time-frame, while Northern and Eastern Regions may be ready only after 2010. The frequency-linked pool scheme can not be used indefinitely. As soon as reforms in a particular region have resulted in a situation of adequate power supply and reserve margins, the frequency-link will no longer work; frequency variations for the most part will have been largely eliminated. This suggests that the earliest switch-over periods speculated here will actually also be the deadlines for a given region to move on to spot pools of some kind. The lifetime of the frequency-linked pool scheme is, therefore, about 10 years in the South and West, about 15-20 years elsewhere in India.

## Market Prospects for India: Alternative State Power Reform Scenarios

Making predictions about the pace of Indian economic and power sector reforms is difficult and intrinsically speculative. Nevertheless, it may be useful to hypothesize a range of alternative futures for 2012 (the end of India's 11th plan, for which a number of studies are available). Below, we examine two scenarios: The first assumes the picture under a scenario based on business-as-usual, the basis for which is an extrapolation of the reforms and progress actually achieved over the past decade. The second attempts the more difficult task of asking what is the best possible -- but still plausible -- rate of progress that may be achieved.

Identifying which scenario is more likely to happen is less important than thinking through the implications of each for Nepal's export strategy. In our view, the important points are as follows:

- The greater the success of power sector reforms, the greater the importance of markets becomes. If the new availability and frequency based tariffs are successful in promoting grid discipline, then together with transmission and wheeling tariffs to be introduced shortly by CRC, increased power trading will bring significant benefits to its participants. But in such a market, Nepal will be a price taker: Bilaterally negotiated prices of the type that presently govern exports to Bihar and UP will inevitably disappear.
- The greater the success in restoring creditworthiness of SEBs, the easier it will be to finance IPPs (The difficulties presently faced by SMEC in marketing West Seti power will gradually diminish). The very same factor also favors Indian hydro IPPs, and the competitive pressures on Nepal hydro IPPs (or even NEA) trying to export power will increase. In other words, the more that increasing buyer creditworthiness makes it easier to finance projects, the greater the pressure on price competitiveness; it is therefore vital that Nepalese export projects are not saddled with significantly higher water royalties than their Indian competitors.
- The key to reform in the Northern grid is UP. The critical event is not any loan agreement with the World Bank, but the sustainability of the reforms after the next change of UP Government. If this milestone can be reached, then the prospects for Nepalese hydro exports significantly improves.
- The impact of reform on power demand is unclear. On the one hand, as reform succeeds in eliminating supply curtailments and economic growth accelerates, demand will grow. But at least during the first decade of reform, tariffs will be raised for those who presently use electricity wastefully, providing powerful incentives for more efficient use and hence lower generation requirements. Reduction of pilferage through metering and enforcement will further reduce consumption.

A successful Indian power sector reform will have profound consequences on the prospects for Nepalese hydro-exports. Successful reform significantly increases the prospects for reaching financial closure for hydro IPPs, as well as for larger projects proposed by NEA (or its unbundled successor) as access to Indian markets is assured. But de-regulation of Indian power markets brings heightened competition and price pressures. For Nepal to maintain its competitive advantage in such an environment, a transparent regulatory regime and a tax and royalty environment that takes into account the realities of the marketplace are all the more important. If Nepal, as a price taker in such markets, obtains no economic benefits from such exports -- or if the Indian market price does not reflect the

environmental and social costs of producing hydropower – then such export projects should not be undertaken<sup>40</sup>.

### India's Power Sector in 2012 – An Optimistic Scenario

Under more optimistic circumstances, one can expect that the reforms presently contemplated in the Northern Region will be implemented and prove sustainable, notably in the wealthier states of Haryana, Punjab and Delhi, and in UP. This leads to robust growth in demand in the Northern Region; economic growth in several of the reformed states picks up; and grid discipline in the Northern Region improves to the point at which synchronization with the Western and Southern Regions is successfully accomplished during the 11th Plan period. Privatization of distribution in Haryana, Delhi and western UP greatly improves the power sector's financial position, and several large IPPs in these states successfully reach financial closure by 2007. Although the need for new generation plants in the period 2003-2008 is slightly diminished as T&D losses are reduced, by 2009 significant additional peaking capacity is required, creating new opportunities for dedicated export projects in Nepal.

The success of reforms in the Northern Region, and synchronization with the West and South, leads to the emergence of a national market:

- The new transmission tariffs put in place by the Central Regulatory Commission prove successful in promoting power trade, and improving creditworthiness of the power sector makes possible smooth commercial arrangements for exchanging and trading power between regions and states.
- Off-peak prices in a national pool will be set by the variable operating cost (fuel and variable O&M) at NTPC's coal-based, mine-mouth stations in the East. Baseload plants in the West and South based on imported coal (and LNG) will have higher costs, and such plants will be backed down. As discussed below, this will result in off-peak prices of around 2 US cents/kWh. In a fully synchronized national grid, there will be nationwide competition in the off-peak hours among IPPs, the more efficient state generating companies<sup>41</sup>.
- During the months of the Southern monsoon, pressure on off-peak prices may intensify as Southern hydro producers run 24hours/day. For example, (assuming resolution of the Krishna inter-state water dispute), the Almatti-Tammankal complex can inject 1,100MW 24hours/day in 9 years out of 10 for at least two months/year.
- Deregulation in the power sector is accompanied by deregulation in the coal and natural gas sectors. Gas prices in the Delhi area increase, to parity with imported LNG, as gas price subsidies are eliminated; prices are based upon imported LNG. The financial cost of thermally generated peaking power approaches the economic cost of gas-fired combustion turbines, thereby providing an upper limit for peaking power at around Rs 4/kWh (9.7cents/kWh)<sup>42</sup>. At this price, many hydro IPPs in northern India and Nepal become financially attractive.

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<sup>40</sup>The background report on Power Trade (in Section 6.3) presents a methodology for evaluating the opportunity costs of dedicated export projects that would enable HMGN to establish what the minimum water royalty/income tax must be for an export project to proceed.

<sup>41</sup> Prospects for some of the efficient thermal plants owned by the AP Thermal Power Corporation, such as Vijayawada, are very good, as well as those for NTPC

<sup>42</sup>See background report on Power Trade for calculations of netback value.

## India's Power Sector in 2012 – A pessimistic Scenario

A realistic look at what has *actually* been achieved over the past 8 years (as opposed to the hopes and expectations) makes for sobering reading concerning the pace of Indian reform. Perhaps one of the most important observations is that power sector reform is inexorably linked to economic and financial reforms, in general, and to the water resources sector in particular. One of the root causes of the financial malaise of SEBs is subsidized power to farmers for the operation of tubewells – for which a powerful driving force is not just the electoral compulsions of many populist politicians, but the fact that water supplied from India's many surface multi-purpose water projects is similarly highly subsidized. Progress to introduce realistic water pricing in such schemes has been even slower than reform of electricity tariffs.

The second, perhaps more important point, is that India has large, and growing, disparities in regional economic growth. Extrapolating the developments of the last decade, the basis for the pessimistic scenario, it is reasonable to assume that robust economic growth in the South (led by progressive politicians and information technology in Karnataka and AP) and in the West (led by the industrial growth of Gujarat and Maharashtra) will continue, and even accelerate. On the other hand, UP and Bihar will continue to languish economically, and power sector reforms in the agricultural states of Punjab and Haryana, as well as Delhi (though most likely to be in place within another five years) will at best have made only tenuous progress in restoring commercial creditworthiness. A reform program is signed in UP but progress is uneven as politicians are unable to raise tariffs (as occurred to the Haryana reform program in mid-1999).

This scenario has important implications for Nepal:

- Robust economic growth, and strong growth in electricity demand, will be concentrated in the South and West. Already, Gujarat, Maharashtra and AP account for the majority of operating IPPs – mostly combined cycle plants. Without an asynchronous link into POWERGRID's 400 kv network, Nepalese hydropower cannot reach these markets.
- Transmission links between the West and South increase, and grid discipline and power trading in this region begins. However, Nepal is too distant to be synchronized into the now integrated West/South grid.
- Despite progress on other fronts, inter-state water disputes continue to plague the South, and the Cauvery and Krishna disputes drag on. This holds up over 2,000 MW of peaking power projects (Almatti, Tammankal, Jurala, etc), creating a potential market for peaking power. But even with Upper Karnali and a higher capacity asynchronous link, exports are limited to no more than 300-400 MW, and wheeling charges and transmission losses make sales into this market very difficult. The foreign IPPs involved in Southern Indian hydro projects leave India, making the climate for attracting private capital into South Asian hydro-projects even more difficult.
- The continued absence of reform in Bihar and UP creates substantial risks for Nepal in exporting even 200 MW of power to its contiguous neighbors. The Upper Karnali (or any other large Nepalese project that necessarily implies a large exportable surplus) cannot be financed (even with concessionary aid) because of the risks to NEA's financial position in arrears with UP and Bihar.
- The Power Trading Corporation (PTC) proves unworkable, and the planned mega projects (such as CEPA) to serve the Northern Region are abandoned. Several imported fuel mega projects are built on the West Coast and Gujarat, but these feed directly into the Western Grid, now dominated by Maharashtra and Gujarat.

With reform languishing in the Northern states, financial closure of IPPs – whether Indian or Nepalese –remains extremely difficult as escrow capacity is quickly exhausted. Dedicated export projects such as West Seti are abandoned.

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