

## **Missing Rationale and Discussion on Unbundling of Nepal Electricity Authority**

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### **Introduction**

The unique characteristics of electricity, i.e., real time match in supply and demand, that requires critical co-ordination in system operation had positioned electric power utilities to remain vertically integrated. Vertically integrated electric power utilities are engaged over the entire supply chain of delivering electricity to the consumers; encompassing generation, transmission and distribution. However, the debate of restructuring the vertically integrated electric power utilities surfaced and gained worldwide momentum after 1980s. Out of various factors, the growing evidence of exhaustion in economies of scale in generation, efficiency gains that could be achievable while operating a single stage of electricity business and the regulation issues attached to regulate vertically integrated monopolies primarily pushed the discussion to separate vertically integrated electric utilities. Consequently, various degrees and forms of separation of electric power utilities were implemented under various country settings.

Following the power sector restructuring taking place worldwide, the discussion to unbundle NEA was formally introduced by the Hydropower Development Policy in 2001. NEA implemented functional unbundling in 2001 by separating the generation, transmission and distribution (GTD) services under distinct business groups, currently named as directorates. Further in 2004, account unbundling was implemented which however is limited to keep the separate record of account of operation and maintenance expenses of GTD businesses. The Corporate Development Plan (CDP) that NEA unveiled for the period of 2019-2024 presented the legal separation of GTD business at the end of 2024. The delayed valuation of NEA's operational assets in GTD, occurrence of Covid-19 pandemic, employee's resistance to separation, policymakers' ambivalence towards unbundling and other factors that have not come into the sight yet could have postponed the legal separation to a newer date for which NEA has not updated the CDP.

The new electricity bill that is under consideration in parliament currently also proposes the mandatory unbundling of vertically integrated electric utilities into distinct entities. It appears that the unbundling of electric utility, primarily NEA in present scenario, has received continued attention since 1992. But over the span of 32 years, there are hardly any empirical and theoretical studies carried out in Nepal's context that could clearly illustrate the need, benefits or pitfalls to unbundle NEA. Exception to this is an article published in Vidyut where the author proposes a cautious and deliberate approach towards restructuring (Pun, 2059).

I might be wrong but it appears from regular discussions and interviews that the power sector stakeholders are taking direct reference of the Indian power system to restructure a significantly smaller

power system of Nepal. It is necessary to understand the size of a power system and compare the inherent benefits that a larger power system offers in restructuring. This article based on the review of literature attempts to shed some light over the economic rationale of unbundling electric utilities and discuss empirical findings from few other country settings including that of United States – mother of all reforms (Pun, 2059). In a cautionary note, this article does not intend to provide any explicit recommendations over the unbundling but presents some important rationale that must not be missed to discuss before carrying out any sweeping reforms in power sector.

### **Vertical Integration and Vertical Economies**

Power utilities have long remained vertically integrated and still exist in such form in advanced economies including the developing countries. The economies of scope present in a vertically integrated power utility which results net cost savings against disintegrated utilities make integrated structure a preferred choice. Economies of scope has been exclusively used to calculate the vertical economies that exist within a vertically integrated utility. Economies of scope refers to the cost savings that arises from the joint production of goods or services within a single firm rather than producing it at different firms. The inputs which are sharable – shared inputs – in the production of multiple outputs has been preliminarily considered as the source of vertical economies or economies of scope (Panzar and Willig, 1981). Moreover, the co-ordination economies and the market risk economies are two other factors that results vertical economies and favors integrated structure for a power utility against the disintegrated one (Meyer, 2012a).

Under vertical separation, both information and incentive problems occur whereas vertically integrated structure allows efficient exchange of information to match the supply and demand of power in real-time. This efficient exchange of information as a result of hierarchical co-ordination within an integrated utility results in co-ordination economies. Under vertical separation, separate contracts are required between the market participants; generation, transmission and distribution companies. The internal co-ordination within the vertically integrated firms is expected to be more efficient than the co-ordination using market mechanisms which involves costly, incomplete or inflexible contracts between market participants pursuing different interests. Similarly, having vertically separated utilities require market mechanism that adds transaction costs and exposes the downstream utilities to the risk of price volatility. If the transaction costs are significant or the price volatility is higher, the vertically integrated utility will become cost-efficient.

### **Industry Demand and Cost Minimizing Market Form**

Baumol & Fischer (1978) in their seminal paper discussed the relationship between the industry demand and the number of firms. Given an industry technology, monopoly will be the optimal market form when the magnitude of industry demand is small compared to the cost-minimizing scale of an individual

firm. They further highlighted that the monopoly tends to be a preferred choice as long as the innovation in technology maintain the proportion of cost-minimizing size of a firm compared to the growth in industry demand. In a rough sense, let's assume that the total electricity demand in a geographical location is 10 TWh. If the utility operating in the same region has a network capacity (output) of 25 TWh and the output corresponding to the lowest average cost is 25 TWh, monopoly in network business becomes the cost-efficient market form unless the electricity demand in that region exceeds 25 TWh.

### **Results from Empirical Studies**

The separation of verticals in electricity industry and the associated loss of vertical economies have been intensively examined under various empirical studies. Among the initial studies, Kaserman & Mayo (1991) estimated the magnitude of vertical economies using multistage quadratic cost function for privately owned US electric utilities. For a vertically integrated firm producing sample mean generation and distribution levels (~9000 GWh, ~7000 GWh), the cost savings from joint operation against disintegrated operation was 11.96 percent. Similarly, Kwoka (2002) found substantial cost savings from vertical integration using a dataset of US electric utilities that varies widely on their degree of vertical integration as well as size. Consistent to the earlier results, Meyer (2012) using data of US electric utilities for a period of 2001-2008 also found the evidence for economies of scope between the stages of electricity supply.

In a recent study carried out for the Norwegian electricity industry characterized by the presence of utilities of varied degree of vertical integration, Mydland et al. (2020) estimated the quadratic cost function and found the evidence of both economies of scope and scale in Norwegian electricity industry. Similarly, Jara-Díaz et al. (2004) estimated economies of vertical integration for Spanish electric utilities and indicated that joint generation and distribution saves 6.5% of total cost.

### **Some Final Thoughts on NEA's Context**

From the theoretical discussions and the empirical findings, it is clear that vertical integration results in cost savings which ultimately reduces the cost of electricity for consumers. If we see the generation segment in Nepal's case, the direct share of NEA is gradually shrinking whereas that of subsidiaries and IPPs is continuously growing. The policy of fixed posted tariff rates for power purchase agreement (PPA) with IPPs has prevented competition in generation. Therefore, any efficiency gain that could have been achievable under competition in generation has not been translated into reduced electricity prices. Given the substantial success of private sector participation in generation business, the policy of competition in PPA tariff could help realize the efficiency gains that private sector brings into the generation business.

Minus IPP's generation, the operating power plants under direct ownership of NEA and the transmission and distribution network that NEA currently owns and operate still makes NEA a vertically integrated utility. Given a small power system equivalent to 12 TWh (NEA, 2023) and a load dispatch center efficiently managing the power system operation, the issue with co-ordination has not been visible yet. Adopting the advanced communication and other associated technologies in dispatch operations could further minimize the possible co-ordination issues as the system grows in size.

Despite of large contingent liability resulting from the pool of signed PPAs against the sluggish growth in domestic electricity demand, NEA is absorbing full market risk to purchase power from the generators. This has played a great role to stabilize and maintain the future price of electricity for the consumers. Separation of GTD business that would require contracts and market mechanisms to purchase and sell power including hedging instruments in a small power system could lead to significant transaction costs. The transaction costs outweighing the magnitude of achievable efficiency gains shall do no good but increase electricity prices. Therefore, the integrated operation of NEA in current context have minimized the market risk and shielded the consumers from larger price volatility, even for the future.

As discussed earlier, the presence of economies of scale in network business in general for a relatively small power system presents monopoly as a cost-efficient industry structure. However, currently both NEA and Rashtriya Prasharan Grid Company Limited (RPGCL) are engaged in the transmission business. Compared to the RPGCL, the cost of fund to finance the transmission line projects for NEA is lower. This could result higher tariff to wheel power using the transmission assets of RPGCL. In order to minimize the electricity prices, RPGCL and government should ensure comparable cost of fund for RPGCL's project.

Most importantly, the contentious issue that inclines stakeholders towards vertical separation is the discrimination of the electric utility, especially the network utility, towards the market participants, i.e., generators and distributors. Given the near monopoly of NEA in transmission distribution business, the discrimination in network access, scheduling and dispatch could be faced by the generators. However, the presence of Electricity Regulatory Commission (ERC) after 2017 should mitigate these issues through the formulation and implementation of necessary bylaws.

To summarize, it is clear from the empirical analysis that the vertical separation of electric utilities leads to the loss of vertical economies. The estimation of loss in vertical economies indicate that the size of the power system and the degree of vertical integration i.e., ratio of generation to transmission and distribution, largely determine the extent of loss in vertical economies (or cost increment). Unless the loss in vertical economies or the cost to use market-mechanism is clearly offset by the efficiency gains from vertical separation and competition, it is not advisable to separate a utility into distinct verticals.

Based on the empirical studies and the estimated values of vertical economies, but in a cautionary note, it appears better to unbundle NEA at a range when the size of power system is between 25 TWh~30 TWh. However, a detailed study on the cost characteristics of NEA and estimation of economies in NEA's operation should be carried out prior.

## References

- Baumol, W.J., Fischer, D., 1978. Cost-Minimizing Number of Firms and Determination of Industry Structure COST-MINIMIZING NUMBER OF FIRMS AND DETERMINATION OF INDUSTRY STRUCTURE\*, Source: The Quarterly Journal of Economics.
- Jara-Díaz, S., Ramos-Real, F.J., Martínez-Budría, E., 2004. Economies of integration in the Spanish electricity industry using a multistage cost function. *Energy Econ* 26, 995–1013. <https://doi.org/https://doi.org/10.1016/j.eneco.2004.05.001>
- Kaserman, D.L., Mayo, J.W., 1991. The Measurement of Vertical Economies and the Efficient Structure of the Electric Utility Industry, Source: The Journal of Industrial Economics.
- Kwoka, J.E., 2002. Vertical economies in electric power: evidence on integration and its alternatives, *International Journal of Industrial Organization*.
- Meyer, R., 2012a. Economies of scope in electricity supply and the costs of vertical separation for different unbundling scenarios. *J Regul Econ* 42, 95–114. <https://doi.org/10.1007/s11149-011-9166-z>
- Meyer, R., 2012b. Economies of scope in electricity supply and the costs of vertical separation for different unbundling scenarios. *J Regul Econ* 42, 95–114. <https://doi.org/10.1007/s11149-011-9166-z>
- Mydland, Ø., Kumbhakar, S.C., Lien, G., Amundsveen, R., Kvile, H.M., 2020. Economies of scope and scale in the Norwegian electricity industry. *Econ Model* 88, 39–46. <https://doi.org/10.1016/j.econmod.2019.09.008>
- NEA, 2023. Annual Report, 2023. Kathmandu.
- Panzar, J.C., Willig, R.D., 1981. Economies of Scope. American Economic Association.
- Pun, S., 2019. Whither NEA Unbundling. *Vidhyut* 13, 1–4.