BARDAK
ENERGY & MANAGEMENT SERVICES

335 DUKE RD
DOONAN QLD 4562
AUSTRALIA

11th August 2005

Dr John Tamblyn
Chairman
Australian Energy Market Commission
PO Box H166
AUSTRALIA SQUARE NSW 1215

Dear Dr Tamblyn

Submission on the Review of Electricity Transmission Revenue and Pricing Rules Initial Consultation: Scoping Paper

The attached submission has been prepared by Dr Robert R Booth, Managing Director of the Bardak Group of companies as a personal contribution to the initial consultation. It has not been financially supported by any party and has been provided as an independent but expert commentary on the subject matter.

Dr Booth has extensive experience in the electricity transmission field, having been Chief Engineer Transmission for the SECV, Engineering Commissioner responsible for transmission and other matters in the State Energy Commission of Western Australia, responsible for several private sector transmission projects while a Vice President at CRA Limited, and an extensive involvement in transmission matters in Western Australia while a consultant to mining companies in that State. He has extensive knowledge of overseas transmission matters and is a Distinguished Member of the CIGRE organisation (the International Conference on Large Electric Power Systems).

The reason for preparing the submission is a belief that the matter of transmission pricing has never been adequately dealt with since the coming of the National Electricity Market, and there have been several futile and non-productive efforts to rectify the problems since that time. Dr Booth believes that following the same general line of attack — as is proposed in the Scoping Paper — runs the risk of another non-productive outcome.

What is needed is a fresh approach to the problem of transmission pricing, based partly on the fundamental characteristics of transmission services, and partly on the experience which has been gained overseas, in successful competitive electricity markets.

The Submission outlines the case for such an approach.

Yours sincerely

[original signed]

Dr Robert R Booth
Managing Director

BARDAK
ENERGY & MANAGEMENT SERVICES

335 DUKE RD
DOONAN QLD 4562
AUSTRALIA

Bardak Group

A Commentary on the AEMC Scoping Paper for the Review of Electricity Transmission Revenue and Pricing Rules

August 11th 2005

1. Introduction

The Australian Energy Market Commission (AEMC) has issued a Scoping Paper for a review of Electricity Transmission Revenue and Pricing Rules.

This submission has been prepared as an independent commentary on the proposed approach. The reason for preparing the submission lies in the belief that the matter of transmission pricing has never been adequately dealt with since the coming of the National Electricity Market, and there have been several futile and non-productive efforts to rectify the problems since that time.

Bardak believes that following the same general line of attack — as is proposed in the Scoping Paper — runs the risk of another non-productive outcome.

What is needed is a fresh approach to the problem of transmission pricing — a new paradigm if you like — based partly on the fundamental characteristics of transmission services, and partly on the experience that has been gained overseas, in successful competitive electricity markets.

The Submission outlines the case for such an approach.

The issue of revenue determination has not been addressed here, leaving that topic for others to cover.

2. Transmission Pricing in the NEM

The present system of pricing of transmission services had its genesis in work conducted by the electricity utilities in the mid 1990s. We believe that there was a general lack of a clear understanding of the proper role of transmission in competitive markets at that time, and the result was a system that was complex, contained many arbitrary assumptions (especially associated with the so-called "Cost Reflective Network Pricing" calculations), failed to provide adequate locational signals and contained compromise decisions which negated the whole idea of cost reflective network prices, as envisaged under the National Electricity Code (NEC, now the National Electricity Law or NEL).

The current system has in practice been either further distorted or ignored. Victoria compromised the process by introducing arbitrary cross-subsidies in transmission prices between the five Distribution utilities in order to play a part in broadly equalising end user tariffs. State regulators have generally ignored the results of the detailed transmission pricing calculations and opted for averages applying to particular utilities.

The problems with the method originally proposed in 1997 are generally well understood, and the ACCC, in its major decision authorising the National Electricity Code expressed its concerns, required NECA to conduct a review of the methodology and approach, which was to be completed within twelve months of the authorisation decision. Subsequent investigations by NECA have further documented the deficiencies in the method.

For example, in an Issues Paper dated 14 September 1999, the ACCC stated:

> *"As part of its formal assessment of the NEM access code, the Commission identified a number of specific deficiencies with the proposed arrangements governing the recovery of the costs of providing the transmission network. Specifically, the Code was amended to clarify the rights of network connection applicants to by-pass existing networks and to improve the location incentives of TUOS charges by including an avoided costs test for embedded generators.*
>
> *Moreover, in response to a range of other matters raised by the Commission, NECA agreed to include within the scope of its review of network pricing an examination of:*
>
> - *the locational signals resulting from the transmission and distribution pricing regimes, including the appropriate balance between cost reflective and postage stamp elements of charges and the incidence and treatment of cross subsidies;*
> - *appropriate guidelines for negotiations between Distribution Network Service Providers (DNSP) and embedded generators on the pass-through of the reduction in transmission charges that arises from bringing these generators into the network;*
> - *the appropriate incidence of TUOS charges, and the pros and cons of unbundling transmission and distribution use of system charges; and*
> - *the appropriate powers of transmission and distribution regulators in particular in relation to the development and monitoring of service charters drawn up by Transmission Network Service Providers (TNSP)."*

NECA tried at least three times to conduct such a review and to come up with a more satisfactory outcome, but failed to do so. The NEM continues to exist using the original transmission pricing system, which has been modified at the edges, but not in substance.

Typical of the confusion of the proper role of transmission, was the flirtation by NECA, authorised by the ACCC, with entrepreneurial interconnectors or "Market Network Service Providers (MNSP's). While maybe well meaning, the whole concept of MNSP's is fatally flawed, as simple calculations can show. In order to gain sufficient revenue, MNSP's must perpetuate and increase regional price differentials — the very opposite of what one would desire from a national market approach — and they can never operate in a financially viable manner without causing regional price differentials of $12-15/MWh as a minimum.

The MNSP flirtation caused confusion, delay in dealing with the fundamental issues, and was the cause of extended legal actions and costs, and has left the NEM with two installations, now regulated or soon to be regulated, that are decidedly non-optimal solutions.

The MNSP saga was not NECA's finest hour.

Unfortunately, the Scoping Paper follows the same paradigm that has been used in the past, and therefore, in our view, runs the real risk of again failing to provide a more rational and sensible transmission pricing system.

We believe that AEMC should step back and take a fresh approach to the issue of transmission pricing, based partly on the fundamental characteristics of transmission services, and partly on the experience which has been gained overseas in successful competitive electricity markets.

This may well require more time than AEMC has currently allocated, but it is argued that, after some eight years of failure, it is most important that AEMC establish its credentials by succeeding in this matter — one where NECA conspicuously failed in the past. A few more months delay in order to conduct a proper investigation would seem to be well worth while.

3. The Proper Role of Transmission

Recent communiques from the Ministerial Council on Energy have started to define the role of transmission in competitive markets in much more satisfactory terms.

For example, in the MCE report to COAG dated 11th December 2003, they stated:

"While transmission accounts for less than 10%[1] *of the total cost of delivered electricity, inadequate levels of transmission can result in inefficient energy price outcomes. The MCE has adopted the following principles to underpin transmission policy in the NEM:*

- *The transmission system fulfils three key roles - it provides a transportation service from generation source to load centre, facilitates competition, and ensures secure and reliable supply.*

- *There is a central and ongoing role for the regulated provision of transmission, with some scope for competitive (market) provision.*

- *Transmission investment decisions should be timely, transparent, predictable and nationally consistent, at the lowest sustainable cost.*

- *The regulatory framework should maximise the economic value of transmission, including through the efficient removal of regional price differences in the operation of the NEM. "*

We believe that AEMC must now take this statement as setting out a fresh paradigm for transmission pricing, and revise its approach accordingly.

In particular, the facilitation of competition, the elimination of regional price differentials deserve more attention than has been evident in the past.

4. The Cost of Transmission

The ACCC publishes an annual statement of transmission revenues and energy deliveries, from which the average cost of transmission in the NEM can be derived.

In the TNSP Electricity Regulatory Report for the 2003/04 period, published in April 2005, the aggregated revenue from the five TNSP's regulated by the ACCC was $1,305 million, and a total of 182,889 GWh was delivered from them.

This gives an average transmission cost of just $7.1/MWh.

To put this into perspective, the average end-user tariff in the NEM States is a little over $100/MWh — with industrial customers paying less than this and residential more than the average.

1 Actually 7% — see later.

Thus transmission costs only 7% of average end-user tariffs — an even lower percentage than that quoted by the MCE to COAG.

With wholesale purchase costs amounting to perhaps 50%, and distribution tariffs averaging perhaps 30% of the same total, one can validly argue that a simplified approach to transmission pricing should be taken — providing that it is facilitating the operation of the competitive wholesale market which makes up the major share of end user tariffs.

Further more, the makeup of the cost of transmission is such that fixed costs dominate — variable costs (or SRMC) are very low, especially if losses are not included in the transmission cost pool. Thus transmission pricing is largely a matter of the fair and reasonable allocation of fixed costs — not pricing at SRMC which might apply in other circumstances.

And the cost of augmentation is relatively small while the potential benefits are large.

In 1991, the States and the Commonwealth agreed to form a "National Grid" so that the cheapest sources of power could be developed and utilised irrespective of State boundaries. They even resolved that the States should secure easements for the strong transmission lines that would be required. All very sensible and logical.

But we rushed into forming a "National Market" before we built the underlying infrastructure necessary for it to work properly — the National Grid.

Studies by Bardak and Pareto Associates and more recently, by Port Jackson Partners for the Business Council of Australia[2], have demonstrated that, if one re-simulates the operation of the NEM and utilises the lowest cost source of power available in any of the States (after allowing for losses and some increase in exporting State prices), annual savings of the order of $1200 million could be made. Port Jackson Partners calculated that this would reduce average pool prices by as much as 23% or maybe $8/MWh or so.

Last year, following the publication of the Statement of Opportunities which included the first version of the ANTS statement, Bardak conducted an exercise where we took the largest and most expensive interconnection projects as listed in the ANTS — essentially 1400-2000MW HVDC links from Queensland to Bayswater and from Marulan into Victoria and South Australia. Using the capital costs as quoted in the ANTS, reasonably levels of WACC and asset lives and typical O&M costs, we

2 A report entitled Reforming and Restoring Australia's Infrastructure prepared for the Business Council of Australia by Port Jackson Partners Limited in March 2005 accompanied the BCA Action Plan dated April 2005.

calculated that to build a National Grid — one that would probably satisfy us — would add only a little over $1/MWh to the average transmission charge in the NEM — 1% of the average end-user tariff.

But if this investment only eliminated a few of the price spikes which drive up the average pool and therefore contract prices, a reduction of more than $1/MWh in a total which can reach $60/MWh, is, in our view, a lay down miséré. End users would save money over all — $7/MWh according to the Port Jackson Partners calculation.

We acknowledge that a reduction in pool prices of this magnitude would cause problems for generator financial viability — where they should be given a market structure where they have a fighting chance of recovering at least the LRMC of new generation in the NEM while still acting competitively— but this involves changes in the trading system which are beyond the scope of this submission.

The point is that, if Australia genuinely wants an efficient competitive market in electricity, then there is no excuse but to strive for systems and rules which allow the lowest cost power to be utilised and developed irrespective of State borders.

Unfortunately, the complex, obscure and almost unintelligible Regulatory Test process (at least to normal human beings) that apply at the present time, do not follow this logic and make it almost impossible to justify new investment in interconnections.

We also need a strong free-flowingNational Grid for the simple reason that there is and never will be, enough independently owned generating companies in Australia to get vibrant competition in the generation sector. We will never have the 250 participants that PJM has, or the same order in Scandinavia. And we cannot expect the level of divestment and new investment that has given the UK — once a cosy duopoly and then a cosy triopoly — a very competitive generation sector.

5. Market Network Service Providers

In Section 2, it was pointed out that the whole concept of MNSP's is fatally flawed, as simple calculations can show. In order to gain sufficient revenue, MNSP's must perpetuate and increase regional price differentials — the very opposite of what one would desire from a national approach — and they can never operate in a financially viable manner without causing regional price differentials of $12-15/MWh as a minimum.

For example, Murraylink is reputed to have cost more than $200 million in capital expenditure, which would require at least $20 million each year to service capital charges. In fact, when applying for regulated status for this link, Murraylink sought annual revenues of $25 million. But at its nominal rating of 200MW, Murraylink could carry a maximum of about 1580 GWh each year after allowance for some outages and losses. And this is only if the link ran at full load 100% of the time — an impossible outcome.

To generate $25 million of annual revenue, the pool price differential between South Australia and Victoria would need to be as high as $15.8/MWh permanently. Lower and more practical levels of utilisation increase this required differential even further.

This is an impossible outcome, and either the whole concept of the National Grid and rough equalisation of pool prices had to be abandoned, or else the owners of an MNSP could not possibly cover their expenses. In the event, it was the second of these outcomes that prevailed, and no company, to our knowledge, anywhere in the world would now invest on the MNSP principles.

Similar results can be calculated for Directlink.

Why NECA or the ACCC did not do such calculations before initiating and authorising the MNSP provisions of the Code is a mystery.

The third MNSP — Basslink – has more of the nature of a regulated asset than an MNSP, since the owners are remunerated by a "facility fee" paid by Hydro Tasmania and the revenues from trading on differential pool prices is the responsibility of Hydro Tasmania. The owners of Basslink are insulated from the risk of trading and have a relatively secure annual income.

In our view, all references to the MNSP concept need to be removed from the NEL, and the concept itself buried and forgotten.

This is not to say that we are oppose to private investment in transmission — quite the contrary. It would be quite in order to have the TNSP's issue major functional specifications to major additions to their networks and allow the private sector to lodge offers in competition with the TNSPs building the asset.

6. Compatibility with Gas Regime

Not mentioned in the Scoping Paper is the issue of compatibility of the transmission pricing regime with that covering transport of natural gas under the National Gas Code.

At the present time, generation owners do not pay for electricity transmission, but in the gas industry, gas transportation is explicitly charged for and on a distance basis as well. As we get greater integration between the gas and electricity industry, this approach holds the seeds for many problems and incorrect decisions on the siting of new generation facilities.

For example, it could lead to a gas-fired power plant being located at a gas field and cause major investments to be needed in electricity transmission — simply because they would pay for transportation of gas to be nearer to a load centre but would not be charged for electricity transmission.

This argues for a better and more explicit set of locational charges for transmission services — at least to the point where a gas-fired generator is neutral so far as relative gas and electricity charges are concerned in the above example. At the moment. locational signals are given by computing marginal losses which inflate/deflate the energy bids of a generator. These signals are arguably too small to have a major effect.

7. Overseas Examples

There have been many statements made by NECA and others, that transmission pricing is complex and that no-one has the answers. In our view this is simply making excuses for the failure to develop a sensible and fair transmission pricing system in Australia.

Transmission pricing in the UK market in fact works very well and by placing the proper incentives on National Grid Transco, transmission prices in the UK have been restrained to sensible levels and are not subject to great dispute nor is there strong pressure to change the system. Argentina has a very workable transmission pricing scheme that is worth examination.

But in our view, the outstandingly most successful transmission pricing system is that applying in the Scandinavian countries, which is credited by them to have been a major factor in the development of one of the most successful competitive electricity markets operating around the world.

Originating in Norway, the Scandinavian system uses "point tariffs", where transmission charges are levied in a simple fashion at the point of connection to the network. Quoting from a paper by Jon Seben of the Norwegian Regulator (NVE):

"A postage-stamp like transmission tariff system based on nodal pricing has been set up. Border tariffs between Norway and Sweden has been abolished. Transmission tariffs are completely independent of trading agreements.

[in 1991 Norway came] to the conclusion that the tariff system must take the form of nodal prices, or what was called point-of connection (or entry/exit) tariffs. In this tariff system the tariff is referring to each separate node in the interconnected network system. But only nodes where commercial actors are connected are relevant for tariff purposes. By commercial actors we mean generators and end-users, as well as interconnected networks controlled by separate companies (utilities).

The essential future of the point-tariff system is that all money paid for access to the system is collected from the users at their connection point. When a customer pays the tariff and accepts the connection agreement at his connection point, he has access to the whole interconnected network system, and is free to go into trading agreement with any generator or trader, or to buy directly from Nord Pool."

Seben further elaborates as follows:

"In NVE tariff guidelines the principles of the point-tariff system are referred as follows:

- *The network owner shall define connection points where exchange (input or output) of power with others take place (generators, end users, other network owners).*
- *Tariffs shall refer to the connection points.*
- *The tariffs shall over time secure the network owner cost coverage for costs in the actual network including payments from the network to any higher voltage level network with which it is interconnected. The tariffs shall include a reasonable return on investment when operated efficiently.*
- *For customers connected to the network, only one agreement shall be necessary to gain access to the entire interconnected network system, and thus the power market.*
- *Tariffs shall be independent of the trading agreements.*
- *Tariffs shall be public and non-discriminating.*

An important feature for the Norwegian tariff system is also that the network buys all losses and that the costs are included in the transmission tariff cost base.

The Norwegian tariff system is based on a theoretical foundation, but can be regarded as rather pragmatic and simple in its actual adaptation to the theoretical principles."

We believe that a strong case exists for AEMC to conduct a thorough examination of the Scandinavian "point tariffs" system of network pricing with a view to adapting it to Australia conditions.

With its emphasis on facilitation of trading and the elimination of price differentials between regions, the "point tariff" system offers a simple and elegant solution to the Australian problems and one consistent with the role of transmission adopted by by the MCE.

A copy of the Seben paper is included as an Attachment to this submission. Bardak, has much more detail on the Scandinavian practices should AEMC wish to access it.

8. Conclusions and Recommendations

The main conclusions and recommendations arising from this submission are as follows:

- The AEMC should take a fresh look at the issue of transmission pricing, based partly on the fundamental characteristics of transmission services, and partly on the experience that has been gained overseas, in successful competitive electricity markets.

- AEMC should adopt the definition of the role of transmission, as conveyed to CoAG, as its criteria for an acceptable transmission pricing system in the NEM.

- The cost of transmission, as a component of the average end-user tariff, is so small that simple and fair approaches to transmission pricing can be considered, especially those that facilitate trading in the the wholesale market and tend to eliminate pool price differentials between the NEM regions.

- The category of Market Network Service Provider should be eliminated from the NEL.

- AEMC should thoroughly investigate the "point tariff" system of network pricing which has proven to be so successful in Scandinavia, for adoption/adaptation to Australian conditions.

- This approach may well require more time than AEMC has currently allocated, but we argue that, after some eight years of failure, it is most important that

AEMC establish its credentials by succeeding in this matter where NECA conspicuously. A few more months delay in order to conduct a proper investigation would seem to be well worth while.

>>>><<<<

Attachment: Norwegian Paper on "Point Tariff" system

Pricing and Organization of Transmission in an Liberalized Electricity Market - Norwegian Experiences

The ConEnergy Conference
Essen, Germany, February 1998

By Jon Sagen
Norwegian Water Resources and Energy Administration (NVE)

Index:

The Norwegian electricity market

The Norwegian electricity market is today the most open electricity market in the world:

- All customers have access to a competitive market and retail wheeling has been implemented to cover all customer groups, including small households.
- A postage-stamp like transmission tariff system based on nodal pricing has been set up. Border tariffs between Norway and Sweden has been abolished. Transmission tariffs are completely independent of trading agreements,
- The Nordic electricity exchange, Nord Pool, organize a spot-market and a financial settled futures market where it is possible to trade weekly contracts up to three years ahead.
- Dispatching of the system is based on commercial bids both from sellers and buyers of electricity in the market. Also in short-term operation of the network the system-operator are obliged to use market operations as far as possible.
- All actors are free to negotiate bilateral physical contracts. But trade in the futures market is increasing rapidly. In Norway a majority of long-term contracts are now financial, with physical electricity being traded in the spot-market
- Prices in all markets, including bilateral contracts and the retail market relates to the spot-market, and are to a great extent reflecting changes in supply and demand.

Legal framework

The starting point of the Nordic electricity market was the Norwegian Energy Act, which came into force in 1991.

The main objectives of the energy act was:

- Economic efficiency
- Security of supply
- National equalization of electricity prices

The basic assumptions underlying the Energy Act are:

- Economic efficiency is improved by introducing market prices and competition wherever applicable
- But, if there are natural monopolies or dominating actors, regulation is necessary to promote economic efficiency.
- Deregulation of the electricity sector requires an identification of the different functions within the sector and to what extent these functions can be exposed to competition or must be regarded as monopoly functions:

  generation
  trade
  metering and settlement
  system responsibility
  transmission
  distribution
  supply (retail)

A primary role of the authorities is to provide a legal framework for competition in generation, trade and supply and to set up an efficient regulatory regime for the natural monopolies, transmission and distribution.

System responsibility and metering and settlement of physical trading volumes are vital functions in the system, and special attention should be given to responsibility and organization of these functions.

A main objective for the legal framework is to provide open and non-discriminating access to and use of the transmission and distribution networks.

In the Norwegian Energy act this right is provided in one single sentence:

> *"Owners of electricity networks are obliged to place the capacity of the network at disposal for other electricity utilities and for producers and consumers of electricity under tariffs and conditions regulated by the authorities".*

Little happened in Norway the first year after the energy act came into force, even though the network companies was obliged to calculate tariffs and accept third party access. But from 1 May 1992 the market put on speed with new traders entering the market and challenging the previous monopoly of local utilities.

Two important features was introduced in May 1992 and may explain this transformation:
1. A national transmission tariff system was introduced
2. The former generators Pool was opened up for all actors in the market

It is no doubt that both of these features were important for the rapid expansion of the market. In this presentation I will focus on the tariff system.

Transmission tariffs in a deregulated market

Regulation of transmission and distribution tariffs is a main regulatory objective in a deregulated market. Tariffs must be non-discriminating and public. Calculation of tariffs requires unbundling of transmission and distribution from other activities.

The network tariff system was identified as a vital factor in the creation of the electricity market. It was early recognized that an efficient electricity market requires a tariff system with the following characteristics:

- The tariff system must cover the whole market from generators to end use customers.

- The network tariff must be completely independent of the commercial trading agreements.

- The tariffs are charged by network owners at the point of connection to the network and are independent of specific power contracts.

The experiences prior to 1990 showed the importance of these conditions. Since the 1970's Norway had a kind of wholesale market in operation, with a generators pool, wholesale bilateral contracts and a common tariff system covering the central grid. This tariff system was based on the principle of an energy price pr 100-Km following an anticipated network path from selling generator to receiving wholesale utility. Electricity from the pool was priced per energy unit independent of distance, but trading in the pool was restricted to "surplus" power on the margin. It was gradually realized that this tariff system was quite inadequate an inefficient. The principle of contract path pricing made trading over longer distances prohibitive expensive and trading agreements outside the central grid resulted in endless disputes concerning prices and conditions.

Efficient transmission pricing

A theoretical investigation into the economics of electricity transmission was part of the research program preceding the electricity reform. I will briefly recapture the main conclusions from this research.

There are three basic costs of transmission:

- Line flow causing physical losses

- Constraints causing "out of merit" generation (and consumption)
- Costs of additional capacity (which reduces losses and constraints)

The Norwegian transmission tariff is in principle a three-part tariff reflecting this cost structure, with an energy element reflecting the value of marginal losses, a capacity (energy) element reflecting the costs of constraints and a residual element securing cost recovery.

The optimal price for use of an electricity network is equal to the value of marginal losses plus costs of constraints measured at any node in the network system. These price signals are a necessary condition for an optimal solution in accordance with economic theory and are also in accordance with the solution of the operational problem of Optimal Power Flow (or Optimal Dispatch) in an electric network. Short run economic efficiency requires that all actors connected to the system (generation as well as demand loads) act (i.e. set generation volumes and demand volumes) according to short run marginal costs (SRMC) as defined above.

But electricity networks are characterized by high fixed costs and increasing returns to scale, they are so-called "natural monopolies". To explain these technical/economical characteristics of electric networks, it is common to point to factors such as indivisibility in construction, security requirements, need for advance construction, etc.

When we have increasing returns to scale, marginal cost pricing will not cover all production costs. A natural monopoly has joint costs that can not easily be attributed to a single or a limited group of customers (generators, connected utilities/networks and end-users).

Non-linear transmission tariffs with an energy element reflecting marginal losses and constraints and a fixed charge that is neutral to short-term operation of the system can, on a theoretical basis, be regarded as an efficient and optimal transmission tariff. This neutrality requirement is difficult to achieve in practice. For instance, a fixed yearly charge based on some kind of averaging of the residual and joint costs between customers might be so high that some customers choose not to be connected to the network.

Government regulations given in 1991 stated that the tariffs should be defined to stimulate optimal utilization of the network. This requirement must be understood with an eye to the theoretical considerations described above.

Point-of-connection Tariffs

An efficient electricity market requires that the transaction costs in trading is as low as possible. If every transaction in the electricity market must be followed by a parallel change in the network access conditions and payment, this would make trading in electricity both cumbersome and expensive. Both considerations concerning efficiency in the electricity market, and considerations concerning efficiency in network utilization, lead to the conclusion that network tariffs and payment shall be independent of the commercial trading agreements.

Costs associated with utilization of an existing electricity network does not depend upon the physical distance between the parties involved commercial power trading. The costs are solely dependent on how much power the individual generators and end-users put on or take out of the network at any time. In addition the costs are influenced by the network operators decisions concerning reserve margins, constraints and scheduling of the power flow in the masked network. The production volume from a generator put on to the network at any hour is certainly influenced by this generators commercial transaction in the market. But it is not necessary for the network operator to have any knowledge of these commercial transactions to stipulate an efficient tariff reflecting the network costs associated with the inflow of power from this generator.

Considerations as described above lead in Norway in 1991 to the conclusion that the tariff system must take the form of nodal prices, or what was called point-of connection (or entry/exit) tariffs. In this tariff system the tariff is referring to each separate node in the interconnected network system. But only nodes where commercial actors are connected are relevant for tariff purposes. By commercial actors we mean generators and end-users, as well as interconnected networks controlled by separate companies (utilities). The essential future of the point-tariff system is that all money paid for access to the system is collected from the users at their connection point. When a customer pays the tariff and accepts the connection agreement at his connection point, he has access to the whole interconnected network system, and is free to go into trading agreement with any generator or trader, or to buy directly from Nord Pool.

In NVE tariff guidelines the principles of the point-tariff system are referred as follows:

- The network owner shall define connection points where exchange (input or output) of power with others take place (generators, end users, other network owners).

- Tariffs shall refer to the connection points.

- The tariffs shall over time secure the network owner cost coverage for costs in the actual network including payments from the network to any higher voltage level network with which it is interconnected. The tariffs shall include a reasonable return on investment when operated efficiently.[3]

- For customers connected to the network, only one agreement shall be necessary to gain access to the entire interconnected network system, and thus the power market.

- Tariffs shall be independent of the trading agreements.

- Tariffs shall be public and non-discriminating.

---

3 In 1997 Norway introduced incentive-based regulation with fixed income frames (like a price-cap) covering the monopoly functions. The income frames are yearly adjusted for inflation and a yearly reduction based on measured relative efficiency of the network.

An important feature for the Norwegian tariff system is also that the network buys all losses and that the costs are included in the transmission tariff cost base.

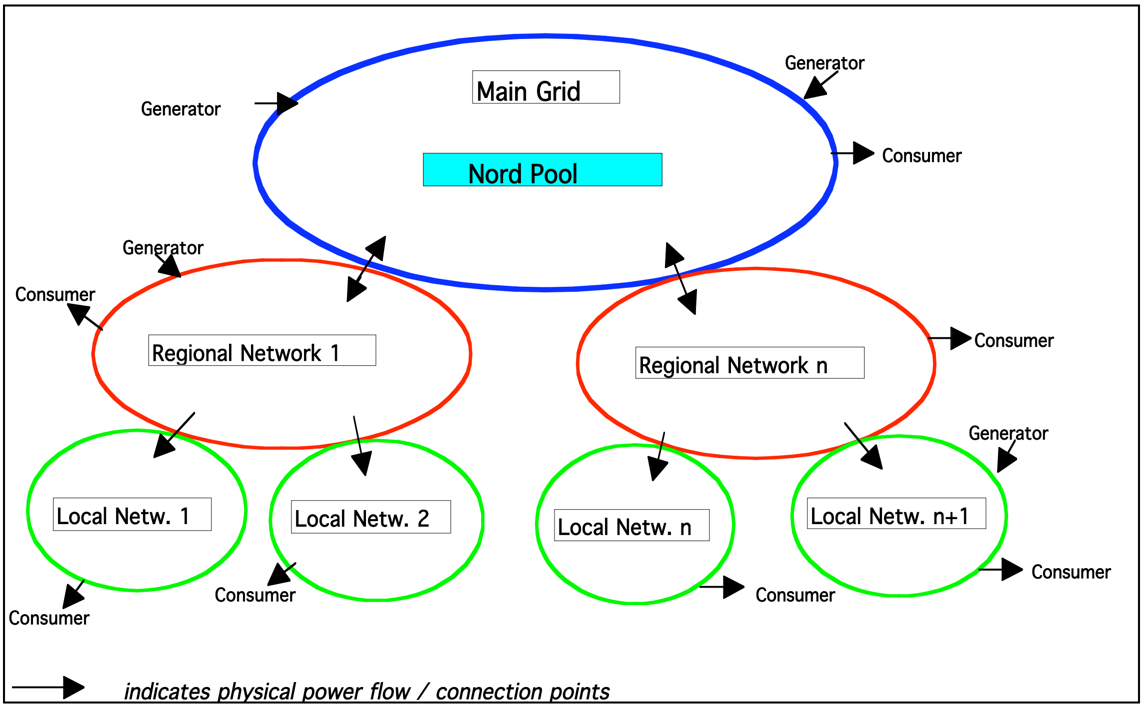

Fig.1: Tariffs are paid at all connection points

Tariff structure in practice

Theoretical considerations require a tariff reflecting locational differences in SRMC at any time in every node in the system. In practice the Norwegian tariff system set up in 1991 was much simpler than this. In the central grid the loss factors was defined for 5 separate areas covering the whole country. The loss factors were also differentiated according to three different load situations during the year. The value of the losses varies hour by hour according to spot price. In the lower voltage networks, regional and distribution networks, the tariff structure is even simpler, often based on an average loss-factor covering the whole year.

From 1 January 1998 the central grid has introduced loss factors differentiated by location, that is by each connecting node. The loss factors are now recalculated every 8th week based on expected average flow on the network.

The actual loss of economic efficiency in the case where transmission charges deviate from actual SRMC, depends on the price sensitivity of generators and customers. End users are generally regarded as having limited price-sensitivity in the short run, while generators can be expected to be more price-sensitive. Any loss of efficiency due to prices that deviate from SRMC must be evaluated against the social gains (benefits) associated with alternative solutions. In this evaluation one must take into account that it is almost impossible to let all actors in the system see actual and accurate nodal SRMC signals hour by hour. In practice SRMC prices have to be calculated in advance for a pre-set period according to expected energy flow on the system.

The Norwegian tariff system is based on a theoretical foundation, but can be regarded as rather pragmatic and simple in its actual adaptation to the theoretical principles. The tariff system was set up in 1991 and was designed as a co-ordinated tariff system comprising all the more than 250 network owners in the country (200 distribution, 60 regional and 20 in the central grid). As the electricity market in Norway in principle should be open to all actors form the beginning; the network tariff system must comprise all actors, from the biggest generator to the smallest domestic customer. Although the tariffs differ in many details, they all relate to a common underlying structure.

Much of the discussion above has been concentrated around SRMC pricing. But on average SRMC prices cover only 30 percent of the total network costs. Cost not recovered by SRMC pricing shall according to NVE guidelines, be collected through a residual tariff component. This residual component shall in principle be neutral to the short-term utilization of the network. In practice this residual component is a load based tariff component related to maximum load. For generators the load is installed capacity available under peak load. For end-use customers the load is measured either as actual load under the peaking hour or as an average of several of the customers max-loads. For small customers with only an energy meter, the residual is collected through a mix of fixed yearly charges and an addition to the energy charge above value of marginal losses.

Not surprisingly a lot of the debate in Norway is related to how this residual component shall be calculated for different voltage levels and customer groups, and to what extent amalgamation of loads in any node shall be the tariff base, or the loads measured at end-use customer level. Geographical differentiation is also a possibility, but is not in practice in Norway. The arguments in this debate are generally related to concepts as "fairness" and "cost-reflective tariffs". Anyone engaging himself in a debate about transmission tariff certainly has to relate to these concepts, but it certainly can be a very confusing debate with as many different opinions as participating parties.

Transmission tariffs and investment incentives - both incentives for location of generators and customers and incentives for building of new capacity in the network - are a question must debated both internationally and in Norway. An optimal solution that can be implemented in practice is not easy to find. A rather pragmatic approach is to regionally differentiate the residual component in the tariff to give signals for location of new generators and end-users. In Sweden the tariffs are differentiated from north to south, reflecting that most of hydro generation is situated in the north. In Norway, with 600 generators scattered around the country, it is difficult to find such a simple principle of differentiation giving acceptable locational signals. It is worth mentioning that network owners in Norway are obliged to do long term network planning and to identify projects that are socio-economic desirable, evaluating benefits for customers (including reduced loss of load probability) against the total system costs.

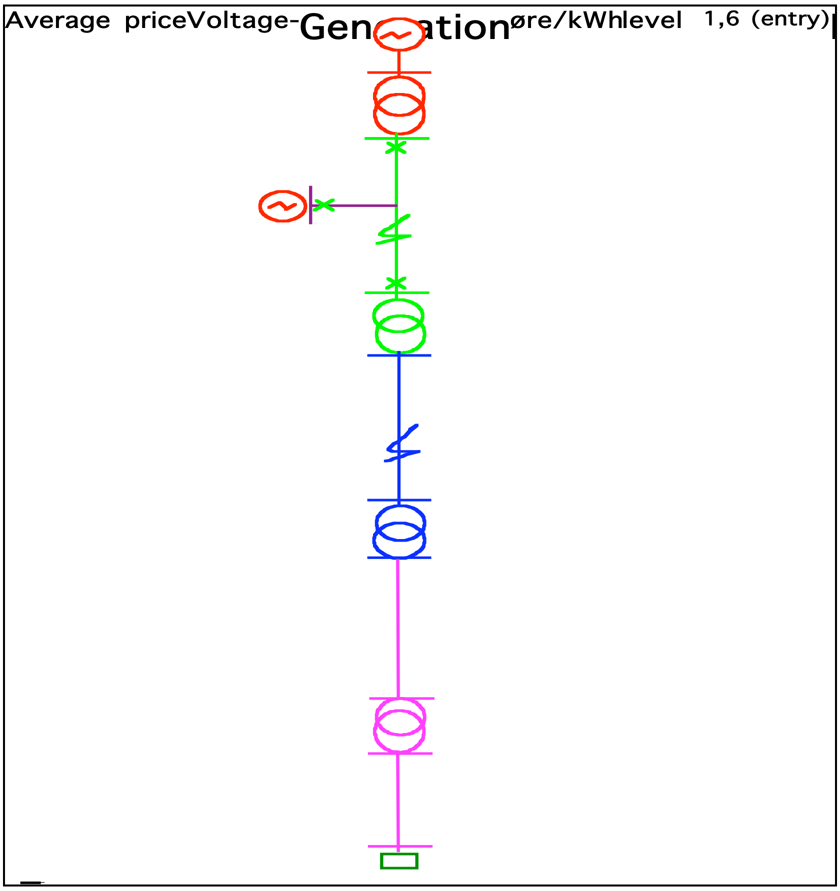

Fig 2: Voltage levels and average price differences

Constraints

In the Norwegian system, constraints are primarily handled by adding a "bottleneck-fee" to the spot price in all nodes that are on demand-surplus side of the constraint, end subtracting an equal fee in all nodes that are on de generation-surplus side of the constraint. Information's from the bidding in the sport market is used to set the bottleneck fee. This information is revealing the different actors willingness to regulate production (and consumption) for a given change in the spot price, and enables the system-operator (Statnett SF - the central Grid Company) to balance the flow with available capacity. This system will normally generate an income to the central grid. This income is part of the companies regulated income and reduces the income it can generate from other tariff elements.

This system is working well in practice, and is quite able to handle actual constraints both in the Norwegian system, and between Norway and Sweden. From an economic point of view it must be regarded as a rather efficient system as it involves all possible loads in decentralized decisions on the optimal adaptation to available capacity.

To the actors in the market, this system of "bottleneck-fees" reveals itself as different price-areas, and the system has drawn explicit criticism, especially from the traders. The argument goes that the system is to complicate and might reduce trading in the different hedging markets.

The critics favour a system called "counter-trade" where the system operator in case of constraints pays generators to regulate up or down. The system operators costs are averaged out to all customers through an uplift in the central grid tariff.

Also in Norway more or less temporarily constraints are handled by counter-trade. The choice between the price-area and counter-trade will to some extent depend on practical considerations and experiences. But in my opinion price-areas is clearly favourable in dealing with more or less permanent constraints between interconnected networks

Responsibility for the overall operation of the system

The function of supervising the overall operation of the system is of crucial importance to the security of supply in any power system. The Norwegian Energy Act states that only one entity may have the responsibility of undertaking this function, and hence the function is regarded as a monopoly. The Norwegian Power Grid Company, Statnett SF, has been assigned this responsibility in the Norwegian system whilst the Swedish Grid Company (Svenska Kraftnett) has been assigned the same responsibility for the Swedish system. A bilateral agreement between the two companies defines the responsibility arrangements for the interconnected Norwegian - Swedish system.

The system supervision function is basically restricted to co-ordination of operations. That is the technical operation of transmission network and production units of importance to the operation of the main grid system. In addition to defining reliability and quality requirements, the supervisor also performs load flow analysis in order to determine network-configuration, detect bottlenecks etc.

The supervisor is given an obligation to monitor the operation of the system. It also has the right to intervene and co-ordinate any such interventions regarded as necessary in order to maintain a proper reliability and quality of supply and/or reduce the costs occurring from reduced quality or interruption of supply. Such interventions may affect the commercial actors in the system, e.g. through a changed mode of operation of production units. Even though being defined as a monopoly function, this supervision function has an important interface with the competitive functions. Accordingly, NVE-regulations explicitly state that Statnett is obliged, as far as possible, to utilize the short-term physical markets in implementing any interventions.

Being a key-element in the development and operation of a deregulated market, I will recommend that special attention be given to the task of defining the responsibility of supervising the overall operation of the system, including the role of and the regulatory framework for the system supervisor.

Cost efficient operation of networks

Economic efficiency is a major objective for any electricity reform. Whilst a lot of attention with deregulation is focused on increased efficiency in generation and supply through competition and open access to the network, efficient operation of the network as such should be given equal attention. To a customer transmission and distribution costs can amount to up to 50% of the total electricity bill.

The networks will remain natural monopolies also in a deregulated system, and today we can draw from a wide range of theory and practice in such regulation. Deregulation requires unbundling of the separate functions of the electricity sector. A major element of this unbundling is separate accounts and cost-data for the different functions. The cost structure of generation and transmission are completely different, but these differences have been given little attention in the economic operation of the traditional vertically integrated utility.

The regulator needs detailed accounting and cost-data, and we have given a lot of attention to set up guidelines for accounting and reporting procedures. With owners engaged both in the competitive side of the business and in the monopoly side, special attention should be given to the problems of cross-subsidies.

Unbundling of accounts and cost-data are essential for the regulator, but the focus on unbundling has also meant a small revolution in the internal economic operation of the utilities. Economic benchmarking of network investments and operation is in the focus, and owners and customers as well as the authorities have put improved efficiency on the agenda.

After several years with cost-of service regulation in Norway, allowing full cost-recovery with a regulated return on capital, we are now introducing formal incentive-regulation. 270 network companies have been given income-frames setting a maximum allowed income for a 5-year period. Any cost reductions beyond a given yearly efficiency requirement will increase the profit. An important feature of this regulatory model is that it will encourage structural changes in the industry when such structural changes can improve economic efficiency.

Regulatory framework for the natural monopolies in the electricity sector is vital for efficiency improvements and cost reductions that can benefit the customers. This is a major challenge and responsibility for the authorities.

Regulatory challenges

The authorities play a decisive role in a deregulation process in the electricity industry.

There are several reasons for this:

- the importance of the electricity sector
- security of supply
- the mix and close connection between competitive and monopoly functions

Our experience is that the authorities, and especially the regulatory authorities, must play a pro-active role in the process. By this we primarily mean that the authorities must set the objectives and a time-schedule. But it is also important to closely monitor the process as it develops. A pro-active role is of course not without problems, and can easily result in a detailed and bureaucratic regulation in contradiction with a commercial and dynamic development of the sector. Responsibilities for the different functions are important. A deregulation process can result in a lot of disputes and the authorities must establish procedures to solve such disputes, either by negotiations or by decision by the regulatory authorities. The regulation of tariffs is a main regulatory functions in a competitive an efficient electricity market.