# Ownership unbundling of electricity distribution networks: an institutional economic analysis

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Abstract

This paper addresses the question whether the operation and management of electricity distribution networks in a liberalized market environment evolves into a market driven commodity business or might be perceived as a genuine public utility task. A framework is developed to classify and compare different institutional arrangements according to the public utility model and the commodity model. These models are exemplified for the case of the Dutch electricity sector. It appears that the institutional organization of electricity distribution networks is at the crossroads of two very different institutional development paths. They develop towards commercial business if the system characteristics of the electricity sector remain basically unchanged to the traditional situation. If however innovative technological developments allow for a decentralization and decomposition of the electricity system, distribution networks might be operated as public utilities while other energy services are exploited commercially.

Keywords

Electricity, liberalization, privatization, unbundling, distribution networks, innovation

# 1 Introduction

Networks are traditionally considered a focal point of regulation in infrastructure-bounded markets. Networks are unique and essential facilities with natural monopoly characteristics. This implies that even in liberalized markets, physical networks represent monopolistic facilities that fundamentally distort market functioning. This particularly concerns energy companies and more specifically electricity companies caused by the underlying physics: electricity cannot easily be stored in large quantities. In order to prevent undesirable opportunistic behaviour of electricity network operators, that is, to gain advantage by hindering third party access, network operations are separated from other core activities such as production, trade, metering and sales. These adjacent commercial activities are subject to competition, whereas the networks have to function as regulated monopolistic activities. This separation between networks and production/trade/metering/sales of electricity is often referred to as ‘unbundling’.

As the first EU member state, The Netherlands is currently preparing a law that forces full ownership unbundling for all distribution network operators (DSOs) and allows for the privatization of the commercial activities (i.e. production, trade, metering and sales). The fully unbundled distribution system operators DSOs remain for at least for 51% public ownership, guaranteeing a dominant political influence in this vital part of the electricity value chain. This initiative is heavily disputed by the incumbent utilities. Government argues however that the operation of distribution networks remains a genuine public task because they secure elementary public services. On the contrary vertically integrated energy firms consider the exploitation and ownership of distribution networks as a commercial business. They are afraid to lose important strategic assets, providing less headroom on the capital market, if they are forced to separate from their networks.

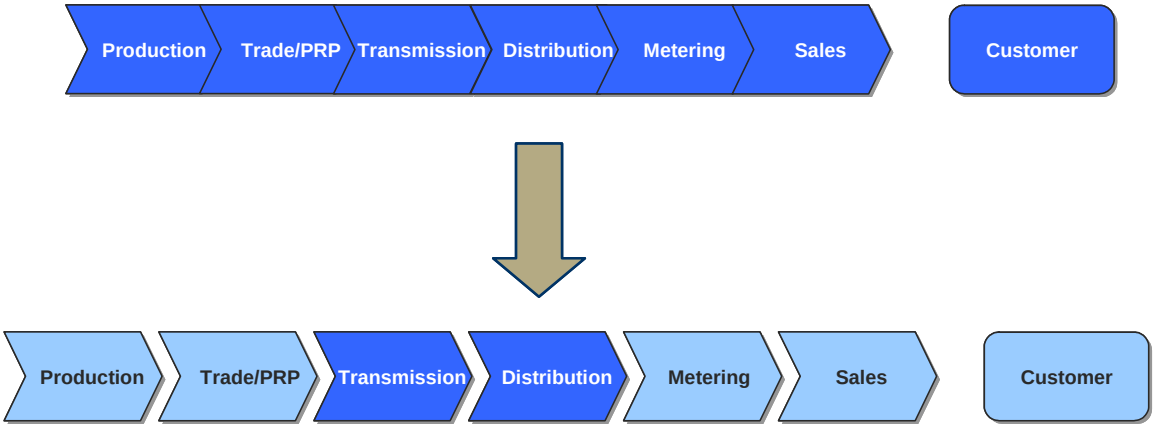
In this article we consider the decision of the unbundling of DSOs as an important element of the choice between fundamentally different institutional regimes in the electricity sector. Is the operation and management of electricity distribution networks in a liberalized market environment evolving into a market driven commodity business, or does it remain a genuine public utility task?

The paper is structured as follows. In paragraph 2 we recap the impact of liberalisation on the value chain of electricity. Paragraph 3 elaborates on the notion of network unbundling and provides a short overview of its implementation in the EU. Paragraph 4 addresses the costs and benefits of ownership unbundling as documented in recent research. In paragraph 5 a framework is presented that allows an institutional analysis of this phenomenon. Paragraph 6 applies this framework for the unbundling case of The Netherlands. Finally, some concluding remarks are summarized in paragraph 7.

## 2 Electricity value chain

Figure 1 depicts an example of an electricity value chain before and after liberalization. Successive technical functions are aligned from generation to final consumption. Prior to liberalisation electricity firms were typically vertically integrated, i.e. all major units of the electricity value chain are included in one single organisation.[1] The most extreme case is shown in the top part of figure 1 below.

*Figure 1: The electricity value chain: from vertical integration to unbundling*[2]




Liberalisation requires a separation of the network related activities (transmission and distribution) form the commercialized parts of this sector. A fully separated, hence fully unbundled, electricity value chain may be considered a basic market design for a fully liberalized electricity market. This corresponds with the atomistic organization of economic actors in a perfect market. The electricity value chain as depicted in figure 1 can therefore be seen as one of the most granular and fundamental descriptions of the playing field of stakeholders and players in the energy domain. This property makes it a generic representation that can be used to assess and analyse not only the electricity market but also the associated regulatory regime. Hence, the six units in the electricity value chain in figure 1 are considered to be the basic building blocks for a market design irrespective of utility jurisdiction. In the electricity value chain two basic flows are recognized that pertain to the underlying dynamics.

The first one is from left to right and is known as the physical flow, electricity is generated at the production unit. This is then traded on the wholesale market in the trade/PRP unit and transported via the transmission unit (highways for electricity) and the distribution unit (regional and local networks for electricity). The electricity is metered during transport not only for billing purposes but also to ensure proper management of the physical flow of electricity in the entire value chain. Meter data is the fundamental information on which the energy market thrives. Finally, in the sales unit the physical flow ends with delivery to the end customer according to the contracts agreed upon.

[1] Next to completely integrated firms as shown in figure 1, also partial integration was quite common. In this case there were two different kinds of integration: production, trade and transmission, next to distribution, metering and sales.
[2] Fens

The second flow is from right to left and is in fact a monetary flow based on contractual agreements. The customer pays for the delivered energy and the monetary value cascades towards the production unit while costs are taken out in transit by the respective units that provide the services to make the energy value chain function adequately. For instance, the sales unit takes out the margin and operational costs required to administer the delivery of electricity. Metering takes out the costs associated with metering services plus a margin. Similar costs for transport and trading are taken out while in the production unit the costs for generating electricity are taken out, also with a certain profit margin. It will come as no surprise that in this flow too, the meter data is the foundation on which the costs allocation in the entire energy value chain is based.

The liberalisation of the energy markets brought about decoupling of the electricity value chain into single entities that can be identified as regulated and non-regulated. In figure 1 the non-regulated, hence market driven, units are presented in light blue while the regulated units are depicted in dark blue. In the bottom part of figure 1 the separation of the units is shown from the perspective of the unbundled situation as envisaged in The Netherlands. In the unbundled situation it is expected that all transport related matters will be regulated and dominantly owned by governmental institutions. The transmission network for electricity will be owned by the central government and operated by fully state owned company Tennet. The distribution networks are currently operated and governed by the incumbent utility companies that are owned by municipalities and provincial governmental institutions. After the unbundling the ownership will probably stay with municipal and provincial government albeit separated from the production, trade/PRP, metering and sales units. These separated non-regulated units may well be fully privatised. Therefore, the current owners, municipal and provincial governmental institutions, will in the end probably sell their interest to investors or even to foreign utilities that will inevitably seek growth.

As stated in the introduction, this article addresses only the merits of the ownership unbundling of distribution system operators.

## 3 Network unbundling

In general four different models for unbundling can be distinguished, presented in increasing order of magnitude of economic and legal separation:

- Administrative unbundling: different accounts for the network exploitation and for sales/production, shared operational activities in one company;
- Management unbundling: in addition to the administrative unbundling, the staff is assigned to different business divisions/units that function independent from other business activities, but still managed from a central holding;
- Legal unbundling: network activities are organized in a separate legal entity, which might however function in a holding company together with production and sales activities;
- Ownership unbundling: the network is functioning under different ownership than production and sales, thus no encompassing holding and no shared operational activities.

As part of the liberalization of the electricity markets, EU regulations (Electricity directive 2003/54/EC) require the legal unbundling of all networks (i.e. transmission and distribution) from the remaining units in the electricity value chain. However, the time path is somehow divers with respect to the units transmission and distribution. Transmission network operators have to be legally unbundled as of July 1st 2004 and distribution network operators by July 1st 2007. This means that theoretically the unbundling of transmission network operators (TSO's) is finalized by now; while the restructuring of the distribution network operators (DSO's) is still in progress.

Although there is no obligation for ownership unbundling arising from the EU-directives, eight EU countries opted for their transmission network operators for this most far-reaching case. However, the unbundling of distribution network operators develops far more reluctantly until now (see figure 2). To date 16 out of 26 member states do not meet the requirements yet, and 2 countries have not unbundled at all[3] This illustrates that there is still a long way to go for most countries to meet EU requirements. It is however striking that there is no case of obligated ownership unbundling of DSOs, even not in countries that are considered the European champions of liberalization like the Nordic countries and UK[4].

Note that in the UK the DSO's unbundled voluntary in the mid nineties and the UK electricity market is considered the most advanced when it comes to deregulation and privatization. UK legislation allows for ownership unbundling on a voluntary basis. Out of the 12 distribution and supply companies, five have opted for ownership unbundling.[5] It should be noted that in this case no privatization is involved since the property rights remain within the private sector as before. Ownership unbundling seems to be related to the specialization of private business.

In the Scandinavian model (liberalised for electricity as of 1996) the TSOs and DSOs are fully regulated and governmental owned. Also the Scandinavian electricity market (Norway, Sweden, Denmark and Finland) is considered a prime example in electricity market liberalisation, albeit with a market design that fundamentally differs from that in the UK.

From figure 2 it can be concluded that the most common models are legal unbundling and unbundling of accounts.

*Figure 2: Distribution network unbundling in the EU[6]*

| Basic unbundling model | Number of EU member states |
|---|---|
| Ownership | 0 |
| Legal | 10 |
| Accounts | 9 |
| Management | 4 |
| None | 2 |

[3] EU energy market liberalization statistics 2005, COM (2004) 863 final, technical annexes, annex 1.
[4] Recently the European Commission decided to investigate the desirability of ownership unbundling of DSO's for the European Union. Robert Klotz of the EU competition department on a conference in Koenigswinter (Germany) 25-5-2005.
[5] Van Damme et.al.
[6] EU statistics

# 4 Costs and benefits of ownership unbundling

The merits of ownership unbundling might be evaluated by a comparison of costs and benefits. A recent study by the Netherlands Bureau for Policy Analysis (CPB) follows this approach with results summarized in figure 3.[7] The performance criteria of this study are based on arguments that are brought forward in the current political debate on the perceived (dis)advantages of the proposed law.

Potentially there seem to be mayor benefits while very high costs associated with unbundling are indicated. This makes the net balance on the effects of ownership unbundling rather ambiguous. Besides, two important factors of uncertainty are recognised. Firstly, the one time transaction costs (e.g. disentanglement of current intertwined admin and operational systems) might turn out to be very significant and may ultimately impact the benefits. However, recent studies on business and information architecture show that associated costs can be absorbed in currently accepted cost-to-serve rates. Secondly, the expected positive effect on wholesale competition depends largely on the development and market share of small-scale, decentral generation plants. An increase of small-scale generation would significantly change the current tight oligopoly into a stronger competitive market structure as these systems feed in on the DSO assets rather than the TSO assets. This of course adds to the importance of third party access activities, and associated services, of the DSOs. Ownership unbundling would contribute considerably to the well function of the market, as the oligopoly structure will be challenged.

Nonetheless, much uncertainties and risks are perceived with respect to future developments when ownership unbundling is selected as the model of choice. Consequently, this makes a continuation of the current institutional and regulatory arrangements the safest course of action, although some slight adjustments may have to be implemented to fully comply with EU directives. This result illustrates the current resentments against ownership unbundling of DSO's.

[7] CPB, p.80. The classification scale of the expected costs and benefits (++ to --) is based on the interpretation of the authors.

*Figure 3: Costs and benefits of ownership unbundling*

| **Criterion** | | **Expected benefits or costs** |
|---|---|---|
| Benefits | **Network company performance** | |
| | Better focus on secure financing | ++ |
| | Economies of scale | ? |
| | Effectiveness and efficiency of regulation | ++ |
| | **Degree of competition** | |
| | Retail | 0/+ |
| | Generation/ wholesale | ++ |
| | Benefits of privatization of commercial activities | ++ |
| Costs | **Transaction costs** | |
| | Cross border lease | ? |
| | One off | -- |
| | **Loss of economies of scope** | |
| | Operational | -- |
| | Financial | 0 |
| | Risk of investments in generation | 0 |

This reluctance towards ownership unbundling is not typical for the electricity sector, but is also known in the telecom sector. An OECD study on vertical separation (i.e. ownership unbundling) of the local loop in the telecom sector summarizes similar concerns as follows:[8]

*"Vertical separation is a significant intervention in the marketplace, with substantial and – unlike behavioral regulation which can be reversed –irreversible costs. It should not be undertaken lightly. Seemingly simple in concept, structural separation of the local loop is in practice complex with uncertain outcomes and many questions to be answered. The benefits of structural separation of the local loop are uncertain while the costs are certain and appear potentially large. There is little evidence that the benefits of structural separation of the local loop are sufficiently in excess of costs. Accordingly, it would seem more sensible to persevere with the current regulatory approach (with appropriate improvements and augmented by sanctions). Only if regulatory authorities can show that the benefits are in excess of the costs, and that alternative regulatory approaches would not work, should consideration be given to the structural separation of the local loop."*

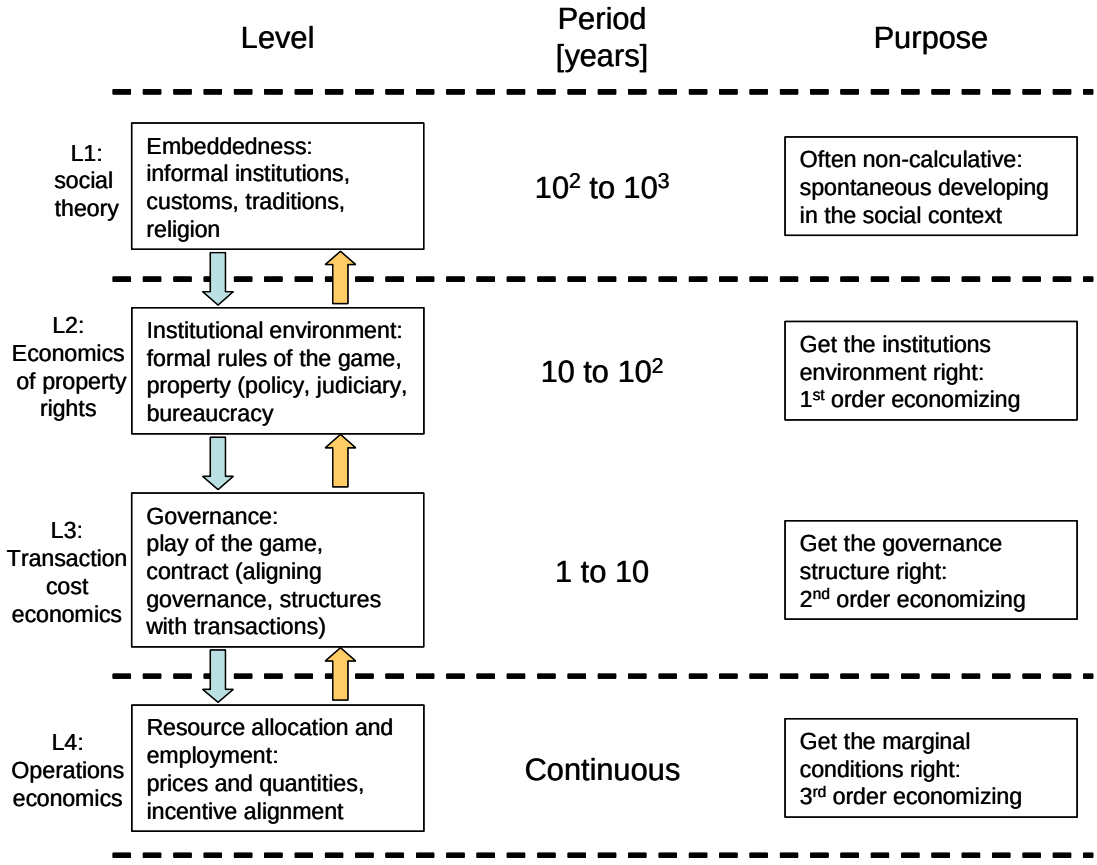
It appears as if there is no clear case for full ownership unbundling for distribution networks. However, we will argue in the following paragraphs that these assessments of costs and benefits are only partial by nature and do not properly take into account the structural change in the electricity sector which involves a fundamental change of institutional regimes. In the next paragraph we will develop a framework for the classification of the structural change in the electricity sector.

[8] OECD

# 5 A framework for the classification of structural change in the electricity sector

Ownership unbundling involves a change of the formal property rights of energy firms. In this paragraph we will argue that the possible consequences of this type of unbundling have to be evaluated within the framework of other institutional arrangements common in the utilities sector. In order to allow this more systematic analysis we will elaborate on a classification scheme for institutional arrangements applied to the electricity sector. A useful starting point for the analysis of institutions in a broad sense is a four-layer model by Oliver Williamson[9]. These four consecutive layers identify different categories of institutions that govern economic behaviour (figure 4).

*Figure 4: The four-layer model of Williamson (1998)*




Level 1 refers to the informal institutions like values, norms, traditions, and customs that influence behaviour of managers and government. It is the level of 'embeddedness' referring to economic and social behaviour that is deeply routed in society and only change on a very long period (according to Williamson between 100 and 1000 years). These institutions emerge spontaneously within the social context, are typically non calculative by nature, and reside in the domain of social theory.

Level 2 refers to the formal institutions such as the legal rules, like property rights and the public organisations like regulatory bureaucracies. This is the area of formal

[9] Williamson 1998

governmental policy that is documented by formal legal processes. The focus is on economic incentives and various opportunities for the enforcement of formal rules. Institutional change might occur in periods of decennia. The liberalization process of the electricity sector is a good example in this respect as the regulatory environment is still in search for equilibrium between public and economic requirements.

The third level is dedicated to 'governance structures' of organisations and contracts that coordinate economic transactions that is often referred to as transaction costs economics.[10] The economic rationale of various contractual arrangements and organisational structures of firms are explained. Periods of change are quite short; typically between one and ten years. Again the electricity sector provides a good example as the governance structures of electricity firms have certainly been object of change in the past years.

At the fourth level the resource allocation is located: the level of actual market processes, for instance as appearing on spot markets and the various attempts for new propositions such as the multi-utility strategy.

The Williamson model not only allows the identification of different categories of institutions, but also the degree of consistency between the four layers. It can be argued that institutions are not randomly developing, but that the layers are interrelated in accordance to a certain logic. For example, lower layers may be considered to form the foundations for higher abstractions upwards in the model. As such the Williamson model can be considered to show the highest abstraction at layer 1 while the most granular level is found at layer 4, the actual economic operations. For example, the formal rules need to reflect to a certain degree the prevailing norms and values. The governance structure in turn builds on the formal rules. Imbalances within these institutional arrangements might cause changes in the institutional arrangements.[11] For instance, in case of full ownership unbundling, that primarily seizes on levels 2 and 3, the electricity companies loose capital headroom (less collateral as networks are extracted from the holding) which makes the acquisition of foreign capital more expensive, and in turn will have its impact on level 4 at resource allocation and employment, hence operations economics.[12]

Thus we apply the Williamson model as defined above to the electricity sector. We distinguish two ideal types of organizations, labelled as the 'public utility model' and the 'commodity model'. These two models adhere to different logics and reasoning of sector organization. In the 'public utility model' the norms and values are primarily based on the idea that the sector predominantly needs to serve public utility objectives. The commodity model is oriented towards promoting competitive markets encompassing the entire product portfolio of the electricity value chain. Thus in the case of the distribution unit this pertains to the electricity 'transport' commodity.

Taking the four layers of the Williamson scheme as a point of reference, we assume the features of the corresponding institutional arrangements that are specified in

[10] Williamson (1985), Fama & Jensen (1983), Fama (1980)
[11] Groenewegen and Künneke, 2005
[12] This argumentation is just an example. It can also be stated that changes at a lower level will initiate processes of change that ultimately results in a readjustment of higher levels institutions. See Groenewegen & Künneke.

figure 5. It has to be noted that these are ideal types of institutional regimes serving the above-mentioned objectives according to economic theory. These institutional arrangements are related to distinctive performance criteria that are mentioned in the last part of the table.

*Figure 5: Features of ideal type models of electricity sector organization*

| | **Williamson layers** | **Operationalization** | **Public utility model** | **Commodity model** |
|---|---|---|---|---|
| Institutional framework | | | | |
| | Embeddedness | Dominant policy focus | Public service/ public value | Competition |
| | | | | |
| | Formal rules | Ownership | Public | Private |
| | | Regulatory framework | Sector specific | Competition policy |
| | | Market structure | Regulated monopoly | Competitive market |
| | | | | |
| | Governance | External governance | Emphasis on political controllability | Emphasis on economic profitability |
| | | | National orientation | International orientation |
| | | Internal governance | Political control | Shareholders control |
| | | | | |
| | Resource allocation | Allocation mechanism | Regulated tariffs | Competitive market prices |
| | | | | |
| Performance criteria | | Economic performance | Acceptable prices and service | Economic efficiency & private profitability |
| | | Public performance | Meeting public service obligations | Competitive economic structures & allocative efficiency |
| | | | Effective political tool | Attractive for private investment |

These ideal models can now be used to characterize the institutional arrangements in the different parts of the value chain of the electricity sector. In the pre liberalization period the electricity sector was often described as a ‘public utility’, which might be interpreted as an orientation towards the public utility model. In the post liberalization period there is more emphasis on the stimulation of competitive markets, signalling a tendency towards the commodity model.

This model of institutional arrangements allows an analysis of the change of ownership in the context of the existing institutional framework of the electricity sector. The relevant question to be asked is whether ownership unbundling fits into the present logic of the institutional arrangements, or constitutes a major disturbance that results either in an unstable institutional setting or a shift towards an alternative model of sector organization. In the first case the change of ownership has no mayor consequences. In the latter case it can be an important step towards a fundamental change of the present institutional arrangements.[13] The logic of institutional arrangements can be analysed in two different respects:

- For the regulated network activities only, thus the distribution unit in the electricity value chain;
- For the consistency of institutional arrangements throughout the electricity sector encompassing the entire electricity value chain.

We will exemplify this analysis for the case of the Dutch electricity distribution networks. In the following paragraph we will first provide a short recap on the current status in The Netherlands with respect to unbundling that accompanied the liberalization process.

# 6 Ownership unbundling: the case of The Netherlands

## *6.1 The Dutch electricity sector*

In May 2005, the Dutch government declared that ownership unbundling should be effectuated by January 1st 2008.[14] The reasoning by the government is as follows: the distribution networks in essence represent a natural monopoly and are controlled by incumbents, the established utilities. This may hinder new entrants to the energy market thereby effectively hampering liberalisation, which will make it more difficult to attain a mature energy market. Consequently, ownership unbundling is seen as the most effective way of supporting the developing energy market. A second justification is security of supply concerning the required investments to keep the distribution network in sufficient shape to ensure transport capacity and thus reliability and long-term security of supply.

In 2004, discussions about the unbundling have been ongoing between the incumbent energy firms on the one hand who oppose the ownership unbundling and the government on the other hand that is in favour. The incumbent firms prefer to retain ownership of (but not necessarily control over) the distribution networks because of the underlying monetary value, which will provide a better position to attract funding on the financial market. Moreover, the regulated transport tariffs will provide a stable income basis that is necessary to be able to fund investments in generation, sales and metering. Utilities want to slow down the process to give them ample breathing space, so that they can properly establish and accommodate the effects of the liberalisation and also to see how the EU level playing field develops and to be able to formulate the appropriate strategy. If unbundling, albeit in a weakened form, is to take place, and recent developments in the EU seem to point in this direction for other countries as well, the current incumbent strategy will probably be to temporise the unbundling.

[13] For a more detailed analysis of the process of change refer to Groenewegen & Künneke

[14] Bill on splitting energy companies to the Lower House, press release Ministry of Economic Affairs, March 2005

The regulator has a pivotal role as well. However, the less stringent the unbundling, the more staff the regulator will need for proper enforcement of regulation. In the event of full unbundling, thus including transfer of property rights as discussed above, less regulation is required as the prevention of monopolistic behaviour is then assumed to be internalized in the public ownership of the DSO's. At the time of writing of this publication the slogan seems to be: *unbundling by law and light regulation*. Heavy regulation will require a large staff at the regulator's office for enforcement.

The current government considers further consolidation to be imminent in the short term and expects Dutch utilities to merge with large EU energy players. According to the Dutch ministry of Economic Affairs it is expected that the utilities in The Netherlands will probably be part of large EU players within five years. This is also the main reasoning why the entire transport infrastructure (comprised of the transmission grid and the distribution networks) should remain in Dutch governmental ownership (ownership unbundling).

The Dutch Energy Council[15], an independent advisory body for the government and the sector, recommended reconsidering the ownership unbundling as currently envisaged. The main issue highlighted by the Dutch Energy Council is the absence of competition at a European level. The EU level playing field has not yet been established. In addition, in a later study in mid 2004 the Dutch Energy Council evaluated the various policy options available for government to establish proper market functioning of the Dutch electricity sector. The major conclusion is that a well functioning wholesale market is a key factor and it is currently considered doubtful whether competition in the wholesale market can be attained. To this end, they argue, the Dutch policy should not diverge too much from the EU developments, aiming at the legal unbundling. It is therefore recommended to only unbundle the networks in terms of legal and organisational perspective but it is not necessary to fully separate ownership as currently envisaged by the government. The Dutch Energy Council state that two main requirements will have to be fulfilled before such ownership unbundling can be considered. Firstly, a well functioning wholesale market (trade unit in the electricity value chain) will exert a larger influence than competition between the sales units at the end of the electricity value chain. Secondly the uncertainty in EU developments towards creating a level playing field needs further clarification.

The incumbent utilities currently postulate that the ownership unbundling as proposed by government will lead to a more expensive, less reliable, less sustainable energy market with less competition. The intrinsic synergy advantages of being fully integrated will (this is however not yet shown in cost-to-serve for the end customer) vanish in the type of unbundling that is envisaged by the government. The government states that the current regulation of access to distribution networks is not sufficiently guaranteed. However this has not been proven yet and the Dutch objective is considered more far-reaching than in other European countries. The incumbent utilities believe that the sector will be weakened by this measure.[16]

[15] AER publication "Behoedzaam Stroomopwaarts" , March 2004
[16] Public Letter in the NCR mid August 2005, by the Ceo's of the four major incumbent utilities in NL

The Dutch regulator fears that unbundling of the networks may lead to less competition in the energy market and that in addition the opportunities for investment in production capacity may be reduced.[17] The regulator suggests searching for alternatives for the unbundling such as a more stringent regulation for network access. However, the regulator also states that ownership unbundling does support a better and more transparent functioning of the energy market, hereby supporting ownership unbundling to a certain extent.

### *6.2 Institutional features of distribution system operators*

We will now apply the different categories of figure 5 to characterize the institutional arrangements for the Dutch DSOs.

Dominant policy focus

The dominant energy policy focus in The Netherlands is often summarized by the following three objectives: affordable, clean, and sustainable.[18] In the past decennium governments tended to assume that stimulation of competition and privatization of energy firms could best serve these objectives. However, since the California energy crisis and several black outs in Europe and the USA, sincere doubts arose on the performance of liberalized markets.[19] Investments in new production capacity and network maintenance and modernization declined drastically. With respect to the distribution networks this reassessment of the sector reform had three concrete results. First the price cap regulation was amended for adding quality indicators. These indicators reflected the reliability of the electricity distribution. Second, a further privatization of the integrated firms was halted. Third, the Minister of Economic Affairs prepared a law that requires complete ownership unbundling of distribution network operators from all commercial activities in this sector. As stated above, for the years to come networks remain public property, with possible minority ownership of private investors. These developments suggest that the operation of distribution networks is best characterized by a focus on public service and public value.

Performance criteria

The relevant performance criteria can be interpreted as a consequence of the policy focus. However, in this respect there appears to be some inconsistency. The regulatory system of price cap regulation provides strong incentives for the realization of economic efficiency and profitability. This fits with the commodity model. The public performance is oriented towards meeting public service obligations, which is in line with the public property model. There is no evidence that networks are perceived as an effective policy tool.

Formal rules

The formal rules of the institutional framework seem to fit the public utility model. Energy firms are still predominantly publicly owned. The shareholders are the Dutch provinces and some municipalities. There is an ongoing discussion on the privatization of energy firms. Provinces and municipalities consider the commercial energy business not any longer as their genuine task. Most public shareholders would like to capitalize their ownership rights. After complete ratification of the law on

[17] Website DTe
[18] " Energierapport 2005", by the Ministry of Economic Affairs, July 2005
[19] Trend in Energy 2004 , Fens et al.

ownership unbundling, the commercial parts of energy firms can be sold on the market, whereas network companies remain dominantly public property. For commercial energy services this would be an important step towards the commodity model.

For the network the regulatory framework is sector specific. The commercial energy services have to comply with competition policy. Network companies function as regulated monopolies, whereas commercial energy services perform in a competitive market environment.

Governance and resource allocation

The external governance of energy companies is oriented towards economic profitability. The business is internationally oriented and the internal governance is in accordance to private sector shareholder control. The resource allocation of network services is based on regulated tariffs, whereas commercial energy services are supplied for market-based prices.

Discussion of the findings

Figure 7 summarizes these findings and illustrates that the institutional features of the Dutch electricity sector are oriented towards the commodity model, especially with respect to the performance criteria and the layer of governance. The formal rules and the policy focus are in between. A change of the ownership structure from public to private appears under these conditions as a very crucial decision that implies an ultimate shift from the public utility to the commodity model.

This change of the ownership structure from public to private generates an institutional framework that is strongly oriented towards the commodity model. This creates strong incentives to align the remaining features over time according to this logic. Meeting basic public service obligations will be part of the business but not a dominant area of public policy. The regulation of networks might also evolve over time towards a more general approach in which competition policy is adjusted to the specific needs of network industries. There are ongoing discussions in this direction, among others on the European level. Under these conditions the traditional public utility model in the electricity sector is replaced by the commodity model. This development is recognizable in some EU countries, including the UK. The sector is completely privatized and the policy orientation is mainly on the promotion of competition, also for the commodity ‘ transport’ offered by the distribution units. Under these conditions ownership unbundling does not bear mayor consequences. The firms are already privately owned, and accordingly there is no mayor change with respect to the formal rules of the institutional framework. Ownership unbundling can be interpreted as an adjustment of the firms’ strategies according to their competitive advantages.

The case is however quite different in The Netherlands. Most of the energy firms are still publicly owned. Unbundling is an attempt to completely separate the networks from the commercial energy services. The Dutch government seems to opt for a hybrid solution in which the public property and commodity model can coexist next to each other. Commercial activities would develop towards the commodity model whereas network companies might even be stronger oriented towards the public utility model. Commercial energy services could be privatized and regulated by competition

policy. These firms could potentially function as other private business firms. Ownership unbundling appears to be a crucial measure to maintain the public utility model for networks in a longer time perspective.

*Figure 7: Institutional features of the Dutch electricity sector organization*

| | **Williamson layers** | **Operationalization** | **Public utility model** | **Commodity model** |
|---|---|---|---|---|
| Institutional framework | | | | |
| | Embeddedness | Dominant policy focus | Public service/ public value | Competition |
| | | | | |
| | Formal rules | Ownership | Public | Private |
| | | Regulatory framework | Sector specific | Competition policy |
| | | Market structure | Regulated monopoly | Competitive market |
| | | | | |
| | Governance | External governance | Emphasis on political controllability | Emphasis on economic profitability |
| | | | National orientation | International orientation |
| | | Internal governance | Political control | Shareholders control |
| | | | | |
| | Resource allocation | Allocation mechanism | Regulated tariffs | Competitive market prices |
| | | | | |
| Performance criteria | | Economic performance | Acceptable prices and service | Economic efficiency & private profitability |
| | | Public performance | Meeting public service obligations | Competitive economic structures & allocative efficiency |
| | | | Effective political tool | Attractive for private investment |

Green: Network Company
Blue: commercial energy services
Grey: both

### *6.3 Institutional arrangements in the Dutch electricity value chain*

Given that ownership unbundling is realized, the next question is under which conditions completely different institutional arrangements can coexist next to each other in an institutional equilibrium in the same sector. 'Institutional equilibrium

would be a situation where given the bargaining strength of the players and the set of contractual bargains that made up the total economic exchange, none of the players would find it advantageous to devote resources into restructuring agreements'.[20]

We will address this problem by referring to the electricity value chain introduced in paragraph 2. With respect to our institutional scheme, the question rises to what degree different models of institutional arrangements can coexist or whether there is a tendency or need for convergence towards a unified institutional model throughout the electricity sector.[21]

This is a very complex question that we are only able to address very superficially. Assuming that electricity networks are natural monopolies, commercially operated firms can gain strategic advantages if they are able to control or influence network related activities. One of the opportunities to prevent this strategic behaviour is an appropriate demarcation between public utility and commodity activities. Throughout the various layers of the Williamson model a very detailed inventory of different institutional arrangements could be made and compared with the 'logic' of the public property model and the commodity model. For each possible combination of arrangements it would have to be analyzed whether they constitute an institutional equilibrium that is long term sustainable. In the context of this paper we are only able to address very general topics and questions that can be identified for each layer. The institutional arrangements cannot be determined in isolation but need to reflect the technical, economic and political opportunities to adequately separate these activities. The value chain of paragraph 2 illustrates several specific features of the electricity sector. We will address some of the problems very briefly in the following as this is ongoing research of which the current status is reported in this article.

Technical demarcation

Problems of technical demarcation between the different activities occur mainly because of the network features of this industry. The network is not a copper plate that is prepared to allow all kinds of economically desirable operations, but need to be adjusted for the available capacity determined by the physical laws associated with generation, transport, distribution and supply of electricity. Since there are only very few (to date rather expensive) opportunities to store electricity, demand and supply have to be adjusted continuously. The network plays an important role for load balancing and other related auxiliary services. Among others, the location of generation capacity and demand within a network matters for the opportunities to provide energy. This offers possibilities for opportunistic behaviour for strategically located generation plants. The boundaries between commercial activities and regulated network operations are also blurred by the technical interrelations between network management and the availability of generation capacity. For purposes of balancing electricity demand and supply network operators need access to storage- or generation capacity.

[20] North, p. 86

[21] Prior to liberalization, the institutional organization of the electricity sector of most countries fitted the public utility model. Vertically integrated firms were common and there was governmental influence throughout the entire value chain either by regulation or ownership. In this sense there was a uniform institutional organization throughout the sector.

The electricity network technically functions according to Kirchhoff's law: electricity flows follow the way of the least electrical resistance. According to the present stage of implemented network technology the flow of electricity cannot be sufficiently controlled. The network functions as an integrated system in which the operation of its components is highly interrelated. It is technically not possible to clearly separate or isolate the operation of mayor components without endangering the integrity of the system. This holds especially for distribution networks as they are more finely meshed than TSO networks.

There might be contractual arrangements or even technological opportunities to solve these problems. But up to now, it is clearly a problem to establish a sustainable demarcation between regulated network activities and commercial energy services. It goes without saying that this demarcation primarily affect the information flow (based on meter data) in the electricity value chain for properly manage network functionality.

Economic demarcation

Traditionally networks are operated as an integral part of the production and supply of electricity. They functioned as a part of a natural monopoly in which an increase of the size of operation allowed for decreasing average costs. Extending networks contributed to the reliability of the system and enabled the realization of economies of scale in generation. System economics could be realized through the establishment of centralized dispatches that allowed the operation of the systems generation capacity in least cost merit order. In this increasing returns economy, size was also important in order to enable firms to collect sufficient financial resources that are needed to fund the large one-time investments for increasing production or network capacity.

Only in the past 25 years, economies of scale in production declined drastically. Even with respect to the operation of networks much smaller scale operation became economic. However, the existing system is still very much functioning under the traditional conditions of increasing returns. Networks inhibit significant path dependence since its mayor components have a very long life period of 40 years or longer. As a consequence, the economic characteristics of networks can only change very gradually over a longer time period. This results in the paradox situation that the components of the electricity industry might function as competitive businesses, whereas the system still inhibits natural monopoly characteristics.

Policy demarcation

With respect to the dominant policy focus a clear differentiation is necessary between the public utility tasks related to networks and the promotion of competition with respect to commercial services. Although this might sound quite straightforward from a theoretical perspective, it has to be considered that the energy policy of many countries does not stop with the physical boundaries of the network. For example, safeguarding security of supply is a quite recognized political objective, which includes next to a well functioning and accessible network, also concerns about sufficient generation capacity or the stimulation of certain technologies (like nuclear power or wind energy). In this sense it is very difficult to define a strict policy demarcation between networks and commercial activities in the electricity sector.

Conclusion
The activities within the electricity value chain are very strongly interrelated with respect to technology, economics and politics. An institutional demarcation of regulated network activities and commercial energy services will only result in an institutional equilibrium if these interrelations can be minimized over time against acceptable costs. Under the current conditions there are inherent technical, economic and political incentives to preserve or re-establish institutional relations that facilitate the management of these interrelated activities. This is even necessary to safeguard the integrity and stability of the electricity system.

# 7 Conclusions

This paper addresses the question whether the operation and management of electricity distribution networks in a liberalized market environment evolves into a market driven commodity business or remains a genuine public utility task. It is argued that a simple cost benefit analysis of unbundling does not take into account the possible change of the institutional regime that governs the electricity sector. In order to cope with this problem a framework is developed that enables the classification of institutional regimes according to two models, i.e. the public utility model and the commodity model. For the case of The Netherlands it is illustrated that ownership unbundling is a very crucial step for setting up an electricity sector organization according to the commodity model. However, the present Dutch government seems to perceive the operation of electricity networks as a public utility task. As an attempt to preserve this situation, ownership unbundling is seen as an instrument to keep networks within the public sector, while commercial activities are completely privatized. This raises the question, whether a long-term institutional equilibrium can be established in the electricity sector with distribution networks being organized as public utilities while commercial energy services are completely liberalized and functioning in a market environment.

It is argued that the various activities in the electricity value chain are strongly interrelated with respect to technology, economics and politics. Especially the network features of this sector preserve the traditional economics of scale and economics of system, even though innovative technologies offer opportunities for small-scale systems operation. As long as these system dependencies are not alleviated, strong incentives will remain required in order to institutionalize these relations in one way or another. This is even necessary to safeguard the stability of the electricity system.

In the Dutch case ownership unbundling of distribution networks might preserve the public utility features of this part of the electricity value chain. However, the co-existence of public utility oriented networks and commercial energy services do not result in an institutional equilibrium under the current technical, economic and political circumstances. From this perspective, it can be argued that networks are evolving into a commercial business like the other activities in the electricity value chain. Ownership unbundling contributes to the institutional instability of the electricity sector.

Nevertheless there is room for another interpretation of this problem. It has been argued that innovative technological developments seem to promote the development

of an electricity system that is much more based on decentralized facilities among others with respect to electricity production, load management and networks. Under these conditions there would be a much lower degree of interdependency between the various activities in the electricity value chain. This offers opportunities to operate networks much more independent from the other activities in the value chain with respect to technology, economics and politics. Ownership unbundling might even stimulate the emergence of such an innovative electricity system.

In summing up, the research problem of this paper can be answered as follows. Electricity distribution networks are at the crossroads of two very different development paths. They develop towards commercial business if the system characteristics of the electricity sector remain basically unchanged to the traditional situation. Under these circumstances the commercialization of essential parts of the electricity value chain will eventually dominate all activities in this sector. A uniform institutional organization is necessary in order to deal with the strong system interdependencies, especially with respect to the network related technology. If however the innovative technological developments allow for a decentralization and decomposition of the electricity system, distribution networks might be operated as sufficiently independent entities. This offers opportunities to maintain distribution networks as public utilities while other energy services are exploited commercially.

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