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# Liberalisation of integrated energy markets and market power issues

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## **Abstract**

*Liberalisation of energy markets has been gradually introduced in many countries during the last 20 years. The liberalisation has led to concerns regarding the state of competition on the markets and fear that market power exists that can result in less efficiency gains than what is expected from liberalisation. Also concerns that specific consumer groups will be hurt by limited competition in markets have been raised.*

*Much of the concern have concentrated on electricity markets, but the development of energy sectors with integration of activities within natural gas, electricity and the oil sector create the need to examine market power aspects across these markets.*

*This paper examine concentration trends in the Northern European markets for electricity and natural gas, combined with regional district heating aspects especially concerning the Danish situation. The situation with natural gas companies supplying both small-scale CHP and retail heat customers is discussed. Which changes of regulatory regime for domestic heat customers should be considered when the natural gas market is being liberalised.*

*The interlinked nature of the energy markets is described and examples of impacts from one market with limited competition to other markets with seemingly well functioning competition are given. Both aspects related to exercise of market power across markets and the regulatory response is considered. The specific case of large CHP production facilities with output on the regulated district heating market and the competitive nordic electricity market is examined. How much of the fluctuations in price experienced in electricity markets should be reflected in the price of heat supplies? To which degree do the heat customers have to bear the burden of low electricity market prices?*

*Regulation of liberalised markets is discussed focusing on the interaction between one regulated market and the related energy markets that are liberalised. Existing regulation on the markets are compared to a situation where liberalisation of some markets puts pressure on other markets.*

*We conclude that the most likely integration activity in the Danish market will be the bundling of energy goods (natural gas and electricity) to retail customers and the integration of gas-fired CHP producers with gas companies.*

**Keywords:** *Energy markets, liberalisation, market power, regulation*

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## 1. INTRODUCTION

The liberalisation of energy markets during the last decade has drawn much attention to the potential use of market power. The literature has concentrated on the electricity sector as the first sector to be exposed to widespread liberalisation. Though there are also studies examining the natural gas sector. However, only a very few studies examine the potential threat of market participants engaged in several energy markets and exercising market power across interlinked energy markets.

Market power issues in the power sector has been extensively studied, (Bower, Bunn, and Wattendrup, 2001),(Garcia and Arbelaez, 2002),(Guan, Ho, and Pepyne, 2001),(Gørtz and Hansen, 1999),(Andersson and Bergman, 1995). There are however a limited number of studies studying the market power issues across the energy markets (Bunn, Dyner, Larsen, and ., 1997). This study focuses on market power arising in the electricity market based on a dominant producer that has generating gas-based capacity. Such a producer might use an option to withdraw some gas-based capacity to increase both spot market prices and volatility. It is possible that the gas can be resold without losses or even with some profit. The gains to the producer will however, mainly be associated with increased price from production at the remaining capacity controlled by the dominant agent and secondarily from increased margins on forward contracts, hedging etc.

Gas market liberalisation has among others been studied by (Lemon, 2002). Other studies consider price effects and positive welfare gains from liberalisation of both electricity and gas markets. In (Aune, Golombek, Kittelsen, Rosendahl, and Wolfgang, 2001) this is analysed in an equilibrium model of the western European markets. The results points to large potential gains, (50%) lower electricity prices and also lower gas prices. The combination of the two markets reinforce the price effects both as a result of the lower fuel prices and because the substitution options between natural gas and electricity in end-use force the gas price down<sup>1</sup>.

Like many others we see a potential threat to a successful liberalisation from the existence of market power. However, market power reduction by strong regulatory incentives may lead to overinvestment that might be just as harmful as the welfare loss associated with too high prices. In other cases regulation in the form of not allowing cross sector activities such as sales of several energy products will not produce market outcomes that are better than having one market player exploiting the possible economies of scope.

This paper is organised with a description of price links and substitution characteristics of energy markets that are important for liberalisation developments in section 2. In section 3 follows a discussion of the liberalisation and resulting consolidation of energy markets that are seen as specifically interesting from a Danish point of view. Thereafter follows section 4 that argues why two specific integration developments in Denmark is seen as most likely and finally follows a policy discussion of the possible adaptation of regulatory policy.

## 2. INTERDEPENDENT ENERGY MARKETS–PRICE LINKS AND SUBSTITUTION

Considering the interdependencies between energy markets it must be noted that energy markets are connected in some ways that are to some extent similar

- a) Energy of one type is used as intermediate input (fuel) in other energy sectors
- b) Different kinds of energy are substitutes in end use demands
- c) There are products that can be supplied in bundles to retail customers with economies of scope

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<sup>1</sup> They assume natural gas supply as exogenous.

The first relation has the consequence that pricing of the one energy type is important for the output price of the final energy product. Electricity produced by natural gas is one example of this. Changes in natural gas, fuel oil or coal world market prices are therefore important for the pricing of converted energy such as electricity and district heat. Liberalising one energy market will thus have consequences for other energy markets.

The second relation has the consequence that anyone selling or distributing energy products have to take into consideration the pricing of other energy goods that are close substitutes to their product.

#### a) Fuel price chains

Fuel price chains will be affected by market power or other market imperfections not only in the first primary fuel market, but also the final demand for input in production or private consumption will be affected. First a too high price on the primary energy product will lead to a reduction of the fuel used in energy conversion if there are substitutes available. This inefficiency will lead to a secondary inefficiency when the converted product has too high marginal production cost. Even though the fuel substitution can accommodate some of the price rise there will be a resulting rise in marginal production cost. In the end the increased price of converted energy will lead to a reduction in the use of this type of energy. The mix between inputs of capital labour and energy may be distorted and inefficiencies in production of other goods might be the result. Correspondingly the private consumption of energy might be reduced to an inefficient level where e.g. too much time and effort is spend on reducing energy consumption.

As there is some difficulties related to the quantification of the right fuel price at first hand it might be that the distortion of prices as a result of market power in the primary fuel market just reduces some other distortion. For instance the absence of environmental taxes on primary fuels in combination with externalities associated with the use of this fuel would suggest that market power results in price increase just as what should be the result of internalising the externality cost. This example is just to point to that there might exist several price distortions in the fuel chain prices and that there is no definite answer to what is the effect of another distortion caused by the exploitation of market power.

The effects of market imperfections such as market power in the primary fuel supply will thus have consequences also in the final energy markets even though the market for these products is seemingly well functioning with widespread competition. For instance a well functioning electricity market could pass an effect of too high gas prices on to the industrial customers.

#### b) Energy supplied to markets with substitution options

In many of the markets where energy products are sold there exist substitution options between energy types. These options have to be considered by any supplier to this market, which have some price setting power. Regulation of the energy types that are substitutes are often quite different. The energy policies have been designed to pursue different goals through time. The regulation of one market has effect on competing product markets. The same applies to market characteristics regarding competition. If one of the competing products are characterised by effective competition the product that are partly a substitute will be exposed to some competition even though the market by itself is characterised by limited competition as either an oligopoly or a monopoly.

Example: For residential heating the supplier of natural gas have to take into account the possibility of expanding district heating and the possibility of switching back to gas oil along

with the possibility of some electricity supplier offering cheap electricity during night times. The scope for such substitution is however rather limited in the Danish case, mainly because the heat planning and district heat have already been expanded to the majority of potential locations.

c) Bundling of energy products and other similar products

There are possible economies of scope by supplying both electricity and natural gas or district heating to retail customers. This can however also be the origin of incentives to exploit market power from one market to another. A distributor that have market power in supplying one product might use this to bundle it with a product in which they have no market power. By supplying both to the customers they will enjoy economies of scope effects that cannot be exploited by the suppliers only engaged in one of the markets.

### **3. LIBERALISATION AND CONSOLIDATION IN ENERGY MARKETS**

Liberalisation of energy markets opens up to consolidation both by allowing new ownership structures and the possibilities of profits in sectors that have until then been regulated by no profits principles. The unbundling of network and other activities also allows for new directions for consolidation e.g with integration of activities within different energy markets. The interesting question is then if there are indications that developments in the structure of energy markets that could create problems for the well-functioning of these markets. Liberalisation is among other arguments based on creating larger geographical markets that will allow more competition and increase effectiveness of the entire market as the most efficient producer and technology capture market shares. Consolidation will therefore not necessarily be any threat to the expected gains from liberalisation.

The agents that until liberalisation had strong positions in the market will try to find means to maintain their position.

#### **Vertical integration:**

Vertical integration will be very likely to take place following the liberalisation. The unbundling of activities within the electricity sector has left separate companies responsible for production, transmission and sales. However, these activities can still have the same owners and some coordination is therefore still possible even though the transmission (system responsible) is regulated in detail. In some cases it is even possible that the link between sales activity and production could become more direct even with common ownership of the two activities. This might be the case in Denmark.

In the fuel chain aspect there are also possibilities for vertical integration with fuel suppliers linking up with electricity producers etc. This is also happening, but has not yet been seen in Denmark. One option is also for considering possible gains from integrating the grid activities both with respect to transmission and the distribution grids. The main obstacle to this seems to be the different ownership structure, but there should be no specific argument about market power as both categories of grids are already heavily regulated.

#### **Horizontal integration:**

Consolidation of regional production and sales companies has taken place within the electricity sector in Europe. Direct mergers but also cross-ownership of companies have reduced the number of independent producers in the Northern European area. This creates a risk for market power arising in the new larger market, but so far it seems that the increase in market size have not been outpaced by the merger and alliance activities. This is said even though markets are not yet fully integrated with respect to price movements, but the threat of new entrants in parts of the regional market is real. In some areas including Denmark, the

integration of the many smaller sales companies have not yet been widespread, but the change is underway. Horizontal integration of production of electricity is a treat to market functioning, but especially in areas where transmission constraints are effective a considerable part of the year. With respect to natural gas the problem could be that the dominant position of established sales companies in their regional markets is not challenged within a reasonable time span.

### **Bundling of energy products:**

In the distribution of electricity there have been activities to create larger business units that could be more interesting for integration activities across distribution markets as oil, gas, electricity and heat. The small supply companies have in a few occasions been acquired by larger scale distributors of natural gas and oil. The other way around is that E.ON still pursues the merger with Ruhrgas in the very large scale business.

The following types of bundling could be considered.

**Natural gas + electricity:** These two products are not substitutes in the residential sector and the electricity is consumed in every single household. Therefore the gas supplier will be able to offer electricity to all of its existing gas customers. This kind of integration therefore seems very likely to appear. For a market power perspective the fear is that if the locally dominant supplier of electricity

**District heat + electricity:** Bundling of these two products seems another possibility especially in the larger district heat areas. The high coverage of the district heat within a specific area makes the integration of activities a relevant option for the two suppliers. Within the district heating area there will be no other supplier of electricity that can enjoy economies of scope in supplying both the heat and the electricity. Therefore an electricity supplier might accept to have a business as the regulated district heat supply without having the opportunity to earn profits on this part of operations.

**Gas oil + electricity:** This bundle is also likely to appear, but the much more geographically distributed sales of gas oil and the more competitive market for gas oil supplies makes this less likely to result in market power. Also the most likely integration will be expanding by offering electricity to existing customers and not by acquisitions<sup>2</sup>.

Bundling might take place with other products of similar characteristics but outside the energy markets. This could be drinking water distribution or even with telecommunications (internet access, cable TV etc.).

### **Liberalisation benefits and the possible distribution of these**

Liberalisation is widely expected to result in efficiency gains through increased competition in markets. It is however not evident who will benefit from the gains in efficiency/productivity. Because energy markets are so interdependent it is not clear whether increased competition in one market will benefit the end-users of that type of energy or it to a larger extent will be transmitted to the energy markets using the first type of energy as a production input.

Example: Electricity markets which are being integrated in larger markets.

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<sup>2</sup> At least not the smaller regional electricity suppliers.

In a region with low production cost the integration with outside markets will lead to more exports if transmission is sufficient and subsequently to higher electricity prices in the region. Is this a positive outcome of the liberalisation? From the consumer of electricity in the region this will not directly be the case, but the rest of the electricity market will benefit from lower prices. In economic terms there will be total welfare gains because the electricity consumed will be produced more efficient on average. The consumer in the liberalising region would however be compensated in the cases where they indirectly own the production sources of electricity. This will hardly be to the same extent as the loss they suffer from higher prices and the liberalisation process would in most cases also mean that the production facilities are transferred to legal companies outside the reach of the individual customers and probably also the liberalisation means privatisation and partly collection of revenues from authorities (municipalities and government).

For the integration this could be an advantage for other markets. Take e.g Norwegian gas that maybe is not competitive in the first isolated electricity case. With expanding electricity markets there will be higher electricity prices and now the natural gas based electricity might be more competitive because the final electricity market have been increased in size. If not exactly the case in Norway the situation where liberalisation of markets proceed in different speeds is quite likely and the existence of transmission barriers (lack of transmission capacity for either natural gas or electricity is also quite likely to occur).

#### **4. LIBERALISATION AND MARKET POWER IN THE DANISH ENERGY MARKETS**

Liberalisation in Denmark have lacked a bit behind the other Nordic countries with respect to electricity but it is probably a bit ahead of some other European countries. For natural gas the situation is that liberalisation has just been initiated in recent years and in practice only a fraction of total supply has been exposed to competition. As the third market district heat is generally a natural monopoly, even though some market setup has been made in the Copenhagen area.

Market power for a small country as Denmark (or for suppliers originating in the country) will be rather unstable as more internationally oriented companies enters the market. The existing suppliers will experience competition in the markets that are easiest to enter and where the price is most important because buyers have fuel substitution options. At the other end residential customers are the least accessible from new (foreign) suppliers and at the same time price is not the only parameter for competition, partly because these customers are levied the highest taxes and partly because they have limited substitution options (price elasticity is rather low).

##### **Liberalisation and market power related to natural gas**

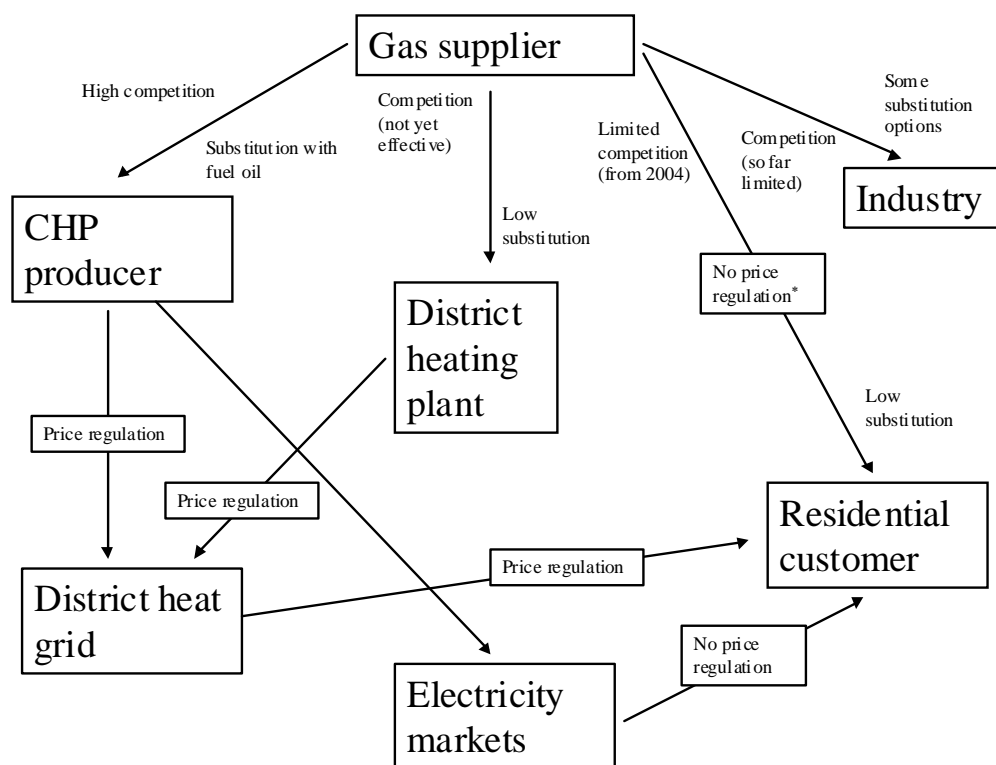
The natural gas markets have longer than the electricity markets been dominated by state-owned monopolies. Liberalisation has taken place in Britain quite early and is underway in many countries in Europe. In Denmark the liberalisation will comprise all customers by 2004. The state owned DONG still control the major part of the market but competitors have entered the market especially for the very large customers as the power plants. The unbundling of grid activities (transmission) the sales activities etc. have been carried out even though the operations is still carried out under the same umbrella. The price of gas has historically been set by regulators to secure the financing of the gas infrastructure and was until a few years ago exempted from energy taxation.

Market power in natural gas might have important implications for the electricity and district heat sectors in Denmark.

- Distortion in retail heat markets – technology choices
- High retail natural gas prices due to district heating being based on natural gas as well makes it easier to raise gas prices. Substitution to other sources than district heat is rather limited in areas already covered by natural gas or district heating grids.

Distortion in heat markets will be limited if seen only at the retail level of gas versus other fuel for residential heating. The only distortion here could be wrong prices resulting in too high or too low consumption of heating in the houses. But this response to prices must be assumed to have a quite limited magnitude. There might be other ways that distortion can be seen, for example through the gas prices for district heating, that could affect the choice of technology when replacing the heat producing facilities.

The following figure captures some of the characteristics of the Danish energy market with respect to market conditions and market structure. The emphasis is on the gas supplier and the residential customer.



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**Figure 1 Energy market characteristics in Denmark**

The figure reflects the market characteristics that are to be the case in the near future. In the figure the gas supplier is viewed as a Danish supplier with sales to all four categories of customers. Of the four customer categories it is the residential sector that seems most exposed to market power as this demand category has low substitution options and the competition is limited. Industrial demand is more flexible with respect to fuel choice and the competition is likely to emerge faster here than in the residential sector. The same applies for the supplies to district heating plants, but they probably have more limited options for fuel

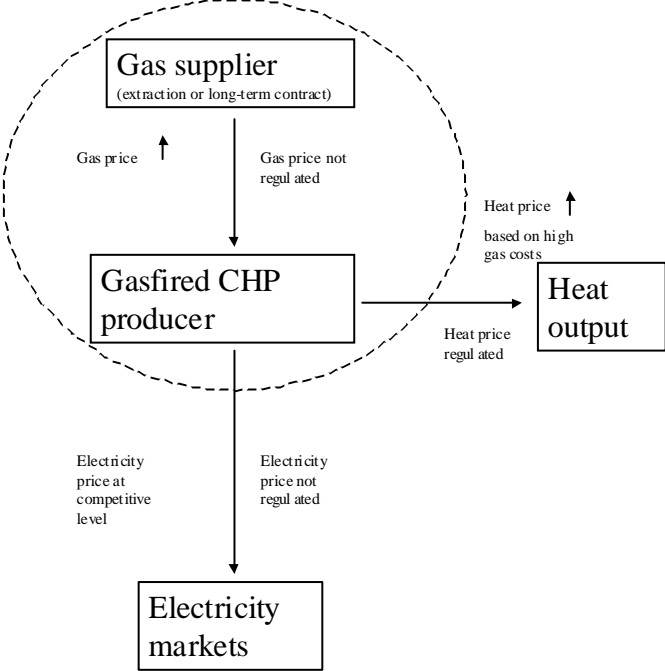
\* Until now the maximum price has been tied to the alternative fuel gas oil. From 2004 this is likely to be free



substitution. For these two groups the treat of future competition would limit the degree to which prices can exceed an anticipated competitive level.

Bundling of energy products is most likely to be seen for the residential customers, where the gas supplies will be relatively uncontested and this situation therefore used to expand into the electricity market. For the other customer categories the bundling is either irrelevant (CHP, district heat) or less likely due to less electricity volume and the more constantly cost-reduction search behaviour from industrial customers.

A different case of integration of energy markets following liberalisation is the incentives that exist for CHP gas based producers and the gas supply companies. This integration might also result in the combined producer having a competitive advantage relative to other gas-based electricity producers.



**Figure 2 Incentives for gas and electricity producer integration in Denmark**

As both electricity and gas markets are being liberalised the ownership structure is opened for changes. Incentives for integration of activities exists that can be actualised when changes in ownership structure becomes possible as a result of the liberalisation. An example is the gas based electricity producer that has additional heat output. This part of output is still under regulation and the crucial point here is whether the gas price paid is the market price or not. This leaves an incentive for an integrated business to increase the transfer gas price to the CHP producer and have part of that increase paid by heat prices. This could be possible if the gas contracts are complex and therefore not easily valued. Integration will benefit from at least two other facts:

1. Reduction of combined gas price risk (the supply businesses will benefit at high prices, whereas the electricity will benefit at low gas prices)
2. Flexibility of gas selling at times of unfavourable electricity prices when already in the gas market

Additional to these two aspects there might exist short-term options for affecting electricity spot market prices if the gas supplier is in control of additional electricity capacity and the gas-based production is the marginal technology.

The incentives for integration exist for CHP producers that are already in operation, but for new capacity the situation will be dependent on the size of the heat market as new CHP heat capacity will only be relevant in the Danish case if old capacity is decommissioned.

## **5. POLICY PERSPECTIVES - REGULATION DISPARITIES BETWEEN ENERGY MARKETS**

There are energy markets that are natural monopolies and there are **elements** of markets that are natural monopolies. These markets need some regulation, but it does not imply that there cannot be gains from allowing other operators in the energy field to expand their activities into natural monopoly areas.

For electricity the liberalisation has raised the need to unbundle activities within transmission and distribution from the production and sale of electricity to allow the regulatory authorities to monitor the monopoly activities. The same is now underway for natural gas. For district heating this is only possible and relevant to a very limited extent. District heating is widespread in Denmark and some of the other Northern European countries. This is in most cases regionally isolated markets and is close to being natural monopolies. Therefore this sector is regulated in detail.

Liberalisation of electricity and gas create incentives for integration that involves several markets and also relates to the heat market as shown in the previous section. Bundling of electricity and natural gas will most likely also occur in Denmark. This would raise the need for regulatory authorities to monitor the price developments for electricity in the areas where the supplier is also the dominating supplier of natural gas. The bundled supply of energy products should not be banned, but it should be assured that the products are available separate in the market at reasonable prices.

The second likely development referred to in the previous section involves gas supplier integration with CHP producers. The regulatory response to such a development will have to deal with monitoring the gas transfer price that is used for the calculation of the regulated heat output price. It must be secured that companies in natural gas and CHP production that are part of the same company are not charging too high a gas price and passing too large a share of that to heat customers whereas cross-subsidising their electricity production that are to be sold in competitive markets. There can however be possible gains from integrating these two activities including reducing the risk premium that CHP producers will need to develop new capacity based on a volatile gas price.

Finally a problem associated with the regulation of electricity production from small-scale CHP can be mentioned. Traditionally in Denmark the regulation of district heat and especially the small to medium scaled combined heat and power production have been regulated with guaranteed electricity prices, such that this was an indirect subsidy to facilitate the expansion with local CHP production in Denmark. However, such policies have important implications for the electricity markets when it is transformed to a competitive market

The share of the electricity output in Denmark supplied from regulated sources are quite high<sup>3</sup> (around 40%) and the market price change for the rest of supply therefore have to be larger to result in a price change relative to final consumers. Secondly the effect for CHP

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<sup>3</sup> The production from renewable energy (wind) and decentral CHP is rewarded with a regulated high price, that has exceeded the market with 50-100%. From 2004 the share of regulated production will probably be reduced when the decentral CHP production will have to operate based on the market price and the subsidy will be given without distorting production decisions.

producers are that there are no price signals to response to changes in electricity market prices. In such cases it is not secured that e.g. reductions in production takes place at the production facility with the highest marginal production cost. As a result there will be a corresponding efficiency loss.

The present development in Denmark is that regulation adopt to the market requirement for liberalisation with the main intention to open the way for possible competition without having to give away domestic markets for the companies in which the authorities have major interest and ownership.

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## REFERENCES

- Andersson, B and Bergman, L. Market structure and the price of electricity. *Energy Journal* **16**(2), 97-109. 1995.
- Aune, FR, Golombek, R., Kittelsen, S. A. C., Rosendahl, K. E., and Wolfgang, Ove (2001) LIBEMOD- Liberalisation model for the European energy markets: A technical description, Ragnar Frisch Centre for Economic Research
- Bower, J, Bunn, D W and Wattendrup, C (2001) 'A model-based analysis of strategic consolidation in the German electricity industry' *Energy Policy* **29** (12) 987-1005
- Bunn, D, Dyner, I, Larsen, E R and . (1997) 'Modelling latent market power across gas and electricity markets' *Systems Dynamics Review* **13** (4) 271-288
- Garcia, A and Arbelaez, L E (2002) 'Market power analysis for the Colombian electricity market' *Energy Economics* **24** (3) 217-229
- Gørtz, M. and Hansen, J. V. (1999) Regulation of Danish Energy Markets with Imperfect Competition, Danish Economic Council Copenhagen, Denmark Download from [www.dors.dk](http://www.dors.dk)
- Guan, X H, Ho, Y C and Pepyne, D L (2001) 'Gaming and price spikes in electric power markets' *Ieee Transactions on Power Systems* **16** (3) 402-408
- Lemon, R. Lessons Learned form Natural Gas Deregulation In: Submitted papers (on CD-ROM). 25. Annual IAEE international conference. Innovation and maturity in energy markets: experience and prospects, Aberdeen (GB), 26-29 Jun 2002. (IAEE, Aberdeen, 2002). 29-6-2002.