2005-012-en

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Power Generation Market Concentration in Europe 1996-2004. An Empirical Analysis.

Berlin, September 2005

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Abstract

The liberalisation of the European power market has significantly changed the framework of the electricity industry. The process of market opening and securing fair, transparent and sustainable third party access is still under way. But (incomplete) liberalisation can be thwarted by concentration trends in the electricity generation market.

This study analyses the market concentration trends in six regional markets in Europe from 1996 to 2004 based on different methodological approaches.

The analysis shows two very different development patterns. On the one hand, the market concentration in the United Kingdom decreased significantly in recent years and lead to electricity generation markets which could be described as unconcentrated, similar to the Scandinavian power production market. On the other hand, market concentration and its trends are occurring in all other regions. In markets which are characterized by former centralized state monopolies, the concentration indicators remain very high. Furthermore, especially in the German market, which is historically characterized by a diversity of power generation, mergers have pushed the concentration indicators to levels which are more and more critical.

Given this background, it is necessary to create more strict competition rules in the electricity markets as a necessary counterbalance to these developments. Key elements of this approach are a stricter unbundling, a premium for decentralised power generation taking into account long term avoided network costs, the elimination of other market distortions as well as disinvestment obligations for market dominating generators.

Acknowledgements

Many colleagues from different companies and institutions supported the data collection process for this study. The responsibility for the content, for any errors or imperfections, lies of course entirely with the authors.

1 Methodological Framework

There are different approaches to measuring market concentration. In this study two different methodologies were combined.

Firstly, analysis was undertaken to identify the different market *Concentration Ratios* (CR) levels. The concept of concentration ratios is used extensively by the German Federal Cartel Office and other authorities.[1] The *Concentration Ratio* CR_n is defined as the market share of the n largest undertakings competing in the market.

$$CR_n = \sum_{i=1}^{n} x_i$$

CR_n *concentration ratio for n largest undertakings competing on a certain market*
x_i *market shares of the undertakings*

The concentration ratio is used by the German Federal Cartel Office following the guidelines given by the Act against Restraints of Competition (Section 19, No. 3)[2]:

"*An undertaking is presumed to be dominant if it has a market share of at least one third. A number of undertakings is presumed to be dominant if it*

1. *consists of three or fewer undertakings reaching a combined market share of 50 percent, or*
2. *consists of five or fewer undertakings reaching a combined market share of two thirds,*

unless the undertakings demonstrate that the conditions of competition may be expected to maintain substantial competition between them, or that the number of undertakings has no paramount market position in relation to the remaining competitors."

Secondly, the *Herfindahl-Hirschman Index* (HHI) is another widely accepted indicator for market concentration which takes into account the relative size and distribution of the companies in a market. It is calculated by squaring the market share of each firm competing in the market and then summing the resulting numbers.

$$HHI = \sum_{i=1}^{m} x_i^{\,2}$$

HHI Herfindahl-Hirschman Index
x_i *market shares of the undertakings*
m number of undertakings competing on a certain market

[1] The indicator concentration ratio was also used in the USA until 1982, when the Herfindahl-Hirschman Index (HHI) was introduced instead of CR4 (Market share of the four largest undertakings on a certain market).

[2] http://www.bundeskartellamt.de/GWB01-2002.pdf

The U.S. Department of Justice states that[3]

"Markets in which the HHI is between 1000 and 1800 points are considered to be moderately concentrated, and those in which the HHI is in excess of 1800 points are considered to be concentrated. Transactions that increase the HHI by more than 100 points in concentrated markets presumptively raise antitrust concerns under the Horizontal Merger Guidelines issued by the U.S. Department of Justice and the Federal Trade Commission."

In Table 1 the specific levels which were derived from these definitions and used in this study for the different concentrations indicators are indicated.

Table 1 Critical Levels for Concentration Indicators

Concentration Ratio CR	Herfindahl-Hirschman Index HHI
Market dominance is presumed if CR1 > 33,3 % CR3 > 50 % CR5 > 66,7 %	Unconcentrated: HHI < 1,000 Moderately concentrated: 1,000 < HHI < 1,800 Highly concentrated: HHI > 1,800

A key issue for the analysis of market concentration is the definition of the relevant markets. However, there is no consensus in the scientific debate on relevant markets as some analysts insist on national markets as the relevant ones while others argue that a more regional view is appropriate.

In this study a mixed approach has been used. For some countries the analysis was carried out for the national market first and then combined with other countries in a second step. The grouping of national markets followed the physical flows of electricity related to the volume of the national electricity markets according to the most recent data published by the Union for the Co-ordination of Transmission of Electricity (UCTE). Based on this data the following regional markets for electricity generation were identified:

- United Kingdom
- Denmark, Sweden, Norway and Finland (Scandinavia)
- Spain and Portugal
- France, Belgium, the Netherlands and Luxembourg[4]
- Germany (with a special focus on the national market), Austria and Switzerland
- Italy, Austria and Switzerland.

[3] http://www.usdoj.gov/atr/public/testimony/hhi.htm

[4] The Netherlands and Luxemburg could also be classified with the regional market of Germany, Austria and Switzerland. But this different classification would not significantly change the results of the analysis.

Subsequently, an analysis was carried out for continental Europe which considered France, Belgium, the Netherlands, Luxembourg, Germany, Austria and Switzerland. But it has to be pointed out that this approach is a more theoretical one given the background of today's reality.

The calculation of market shares in power generation was carried out in a way that took direct control on power generation into account. If detailed data were available, the power generation of undertakings which are owned partly by other firms was counted separately and was *not* summarized to the shareholders. The power generation of single power plants owned by different utilities was, however, differentiated according to the ownership structure. As a result of these assumptions, the analysis can be characterized as a conservative one.

The data for power production of the different undertakings were derived from annual reports, sector statistics and other statistical materials which were compiled in the Öko-Institut's power generation database. The quantification of the different national power generation markets is based on data from Eurostat, UCTE, Nordel and national statistical offices (see Table 2). All analysis is based on net power generation.

This study does not cover the accession countries. For an analysis of these countries a more complex approach is needed which would take into account the liberalization and privatisation process – still underway in some countries – as well as the more complex ownership structures.

Last but not least, the focus of this study is the power generation market. An analysis of the concentration trends in electricity distribution as well as the fast-growing integration of power and gas markets is increasingly important but exceeded the resources available for this analysis.

2 Market Concentration in Different Regions

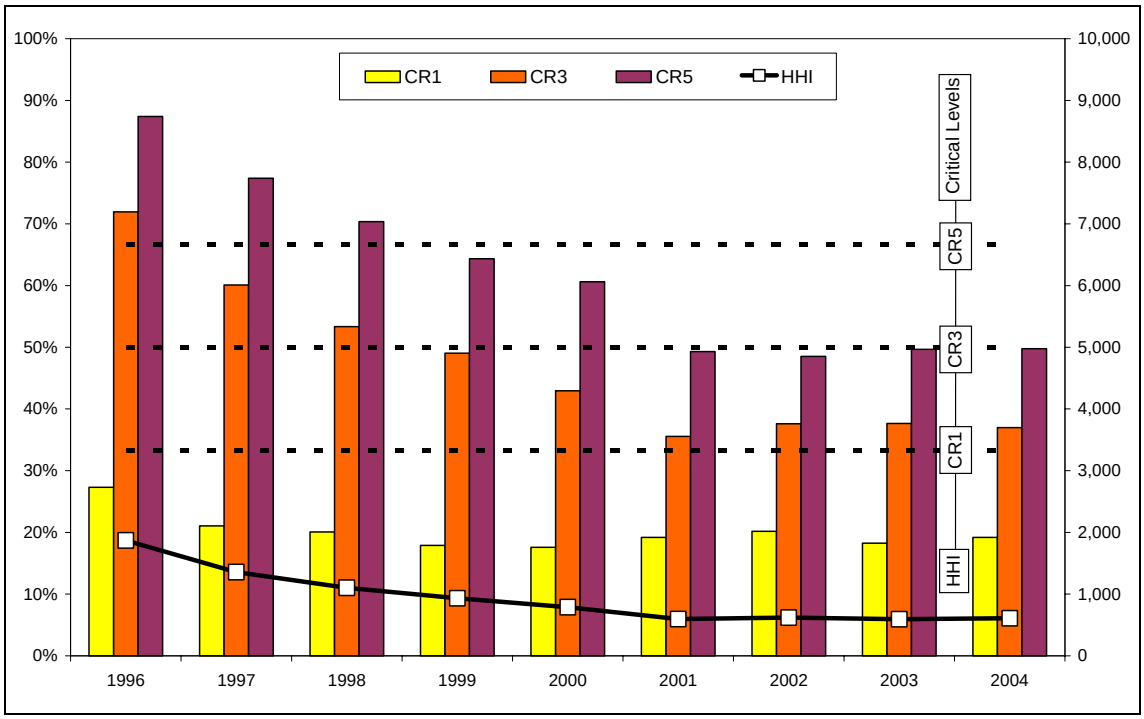
2.1 United Kingdom

Electricity generation increased significantly in the UK between 1990 and 2004 as well as from 1996 to 2004. In 2004 about 379 TWh were generated, which is 26.4 per cent more than in 1990 and 14.8 per cent higher than in 1996.

The electricity market in Great Britain was the first and most strictly liberalized market in Europe. Market liberalization was linked to privatisation which covered most of the non-nuclear generators. According to the Department of Industry, the number of major electricity generators increased from 6 before privatisation to 11 in 1991 and 33 in mid 2001. The big generators were urged to disinvest and a number of new CCGT based generators now operate more than one power plant.

The dramatic changes in the electricity sector lead to a drop in concentration indicators in recent years. Whereas CR3, CR5 and HHI exceeded the critical levels in 1996, the power generation market in the United Kingdom can be characterized as unconcentrated since the year 1999.

Figure 1 *Power Generation Market Concentration in the United Kingdom, 1996-2004*



Source *Öko-Institut calculations*

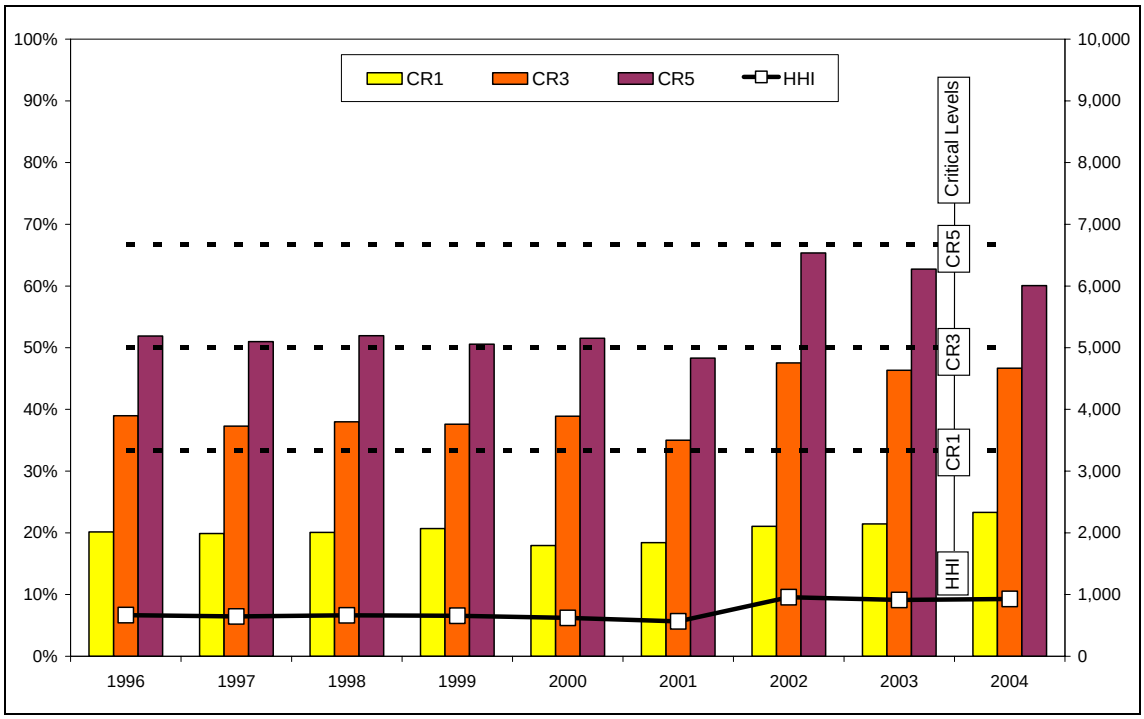
Major players in the power generation market of the UK in 2004 were British Energy (73 TWh), E.ON UK (35 TWh), RWE npower (33 TWh), EDF Energy (25 TWh), Scottish and Southern Energy (23 TWh), Scottish Power (19 TWh) and BNFL (17 TWh).

2.2 Scandinavia

Electricity generation in Scandinavia was about 379 TWh in 2004. Compared with 1990 this is an increase of about 11.8 per cent. Since 1996 the power generation has been expanded by 6.1 per cent.

The Scandinavian power market is characterized by diversified structures and a high level of competition. Neither the CR indicators nor the HHI exceeded the critical levels. Nevertheless, the acquisitions of Fortum and Sydkraft resulted in a slight increase of the market concentration indicators.

Figure 2 Power Generation Market Concentration in Scandinavia, 1996-2004



Source Öko-Institut calculations

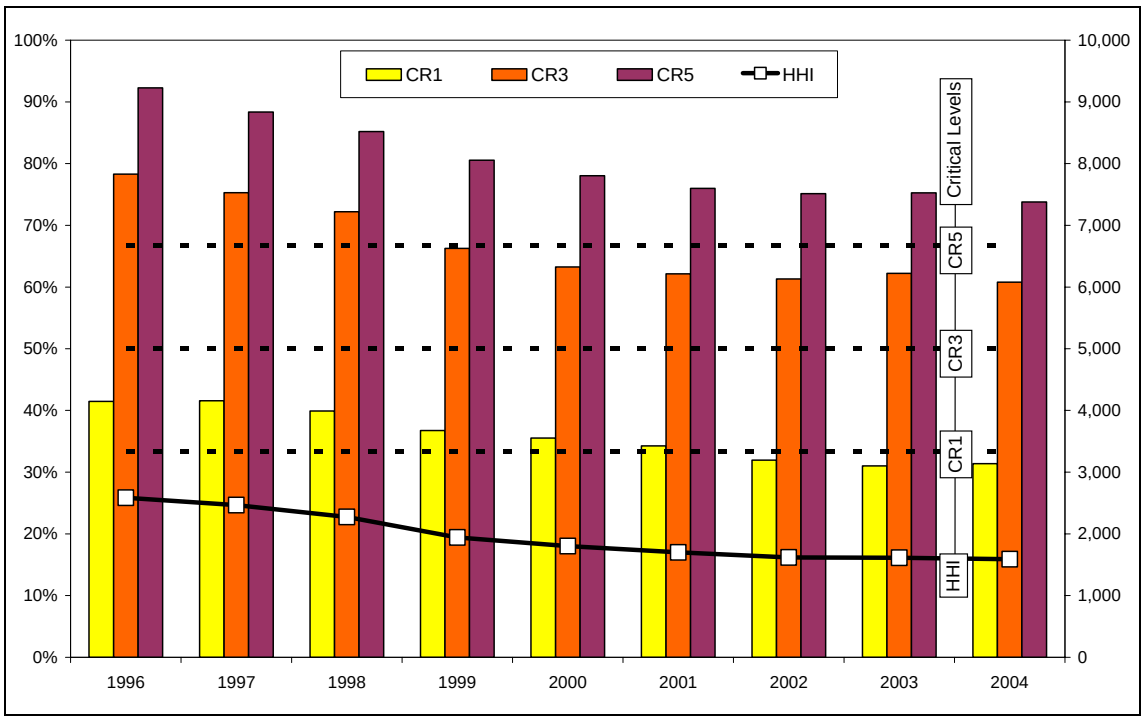
The major players in the Scandinavian power generation markets are the Swedish Vattenfall (88 TWh), Fortum from Finland (54 TWh), the Norwegian Statkraft (34 TWh) and Sydkraft (E.ON Nordic – 33 TWh) from Sweden.

2.3 Portugal and Spain

Power generation in the Iberian Peninsula is a rapidly growing market. The electricity generation in 2004 (about 311 TWh) was 81.1 per cent higher than in 1990 and has increased by about 55.1 per cent since 1996.

Although the concentration indicators show a slightly declining trend, all indicators remain above the critical levels. The sensitivity analysis clearly shows that this situation would not change even if increased electricity imports would be assumed. Given the background of the large increase of power generation the downward trend is a result of the overall growth of electricity production being somewhat higher than the generation growth of the major power producers.

Figure 3 *Power Generation Market Concentration in Portugal and Spain, 1996-2004*



Source *Öko-Institut calculations*

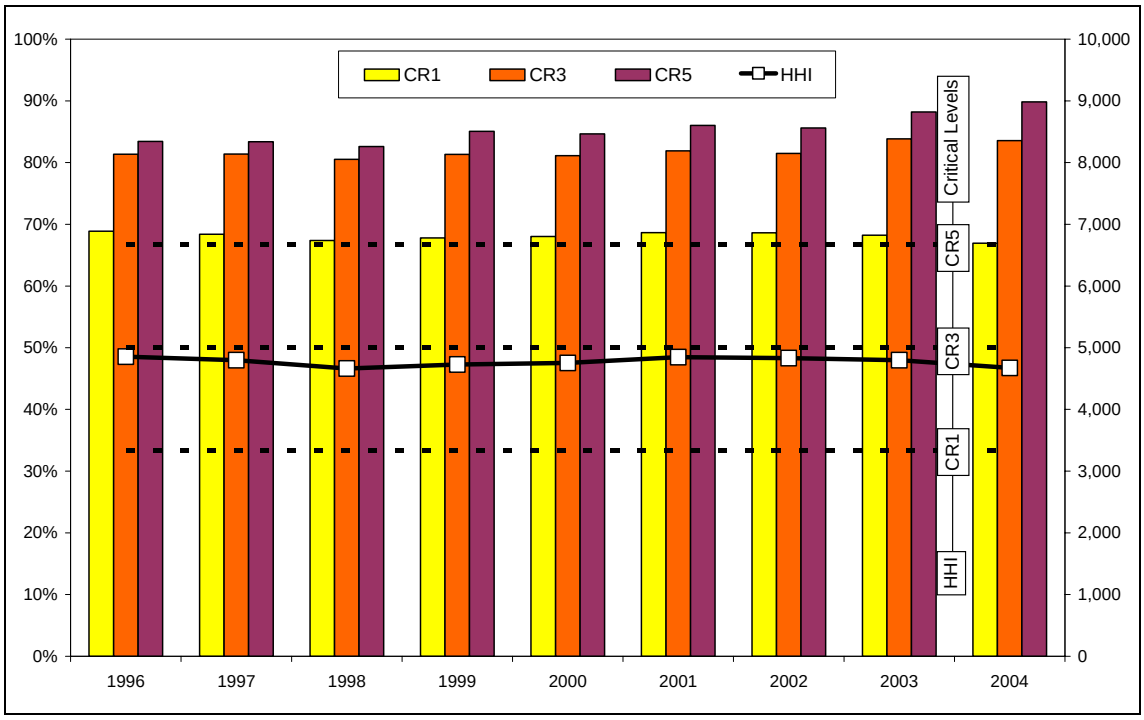
The power generation market in Spain and Portugal is dominated by Endesa and Iberdrola from Spain (98 TWh and 66 TWh) which generate more than half of the total electricity. The other large generators are Union-Fenesa, Hidrocantábrico (26 and 15 TWh, both from Spain) and Electricidade de Portugal (25 TWh).

2.4 France, Belgium, the Netherlands and Luxembourg

The power generation market of France and the Benelux countries is largely dominated by developments in France. In 2004 the power production in the four countries amounted to 728 TWh – representing an increase of 35.1 per cent from 1990 levels and 12.7 per cent 1996 levels. Three quarters of the power generation in 2004 came from France.

The French power generation market dominates the concentration indicators. All indicators significantly exceed the critical levels and no trends of substantial changes can be observed.

Figure 4 *Power Generation Market Concentration in France, Belgium, the Netherlands and Luxembourg, 1996-2004*



Source *Öko-Institut calculations*

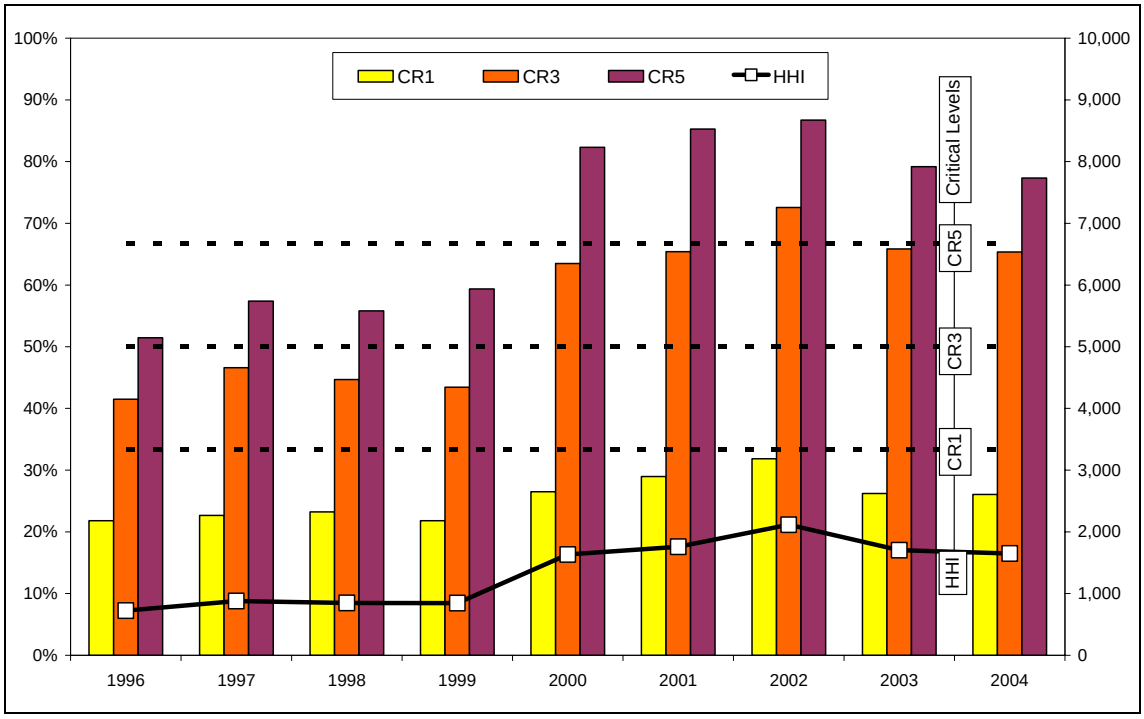
The main players in the power generation market in France and the Benelux countries are Electricité de France (487 TWh) and Electrabel (90 TWh). Although some other undertakings generate significant amounts of electricity (the French CNR - Compagnie Nationale du Rhône and Essent in the Netherlands), they only play a minor role in the market. This can be seen very clearly from the small differences between the indicators CR3 and CR5. Not surprisingly, generators from Luxembourg (Société Electric de l'Our and CEGEDEL) are less relevant in the regional market.

2.5 Germany, Austria and Switzerland

The 707 TWh power generation market in this region is clearly dominated by Germany. In 2004 the German 572 TWh electricity production was about 12.0 per cent greater than in 1990. The increase from 1996 to 2004 amounted to 10.9 per cent.

Whereas the concentration indicators were below the critical levels historically, CR3 and CR5 now exceed the critical levels in the meantime as a result of the mega mergers of EnBW (EVS and Badenwerk), E.ON (VEBA and VIAG), RWE (RWE and VEW) and Vattenfall Europe (HEW, Bewag, VEAG and LAUBAG). Afterwards the HHI accounted for more than 1,650 which is in the upper range of a moderately concentrated market.[5]

Figure 5 Power Generation Market Concentration in Germany, 1996-2004



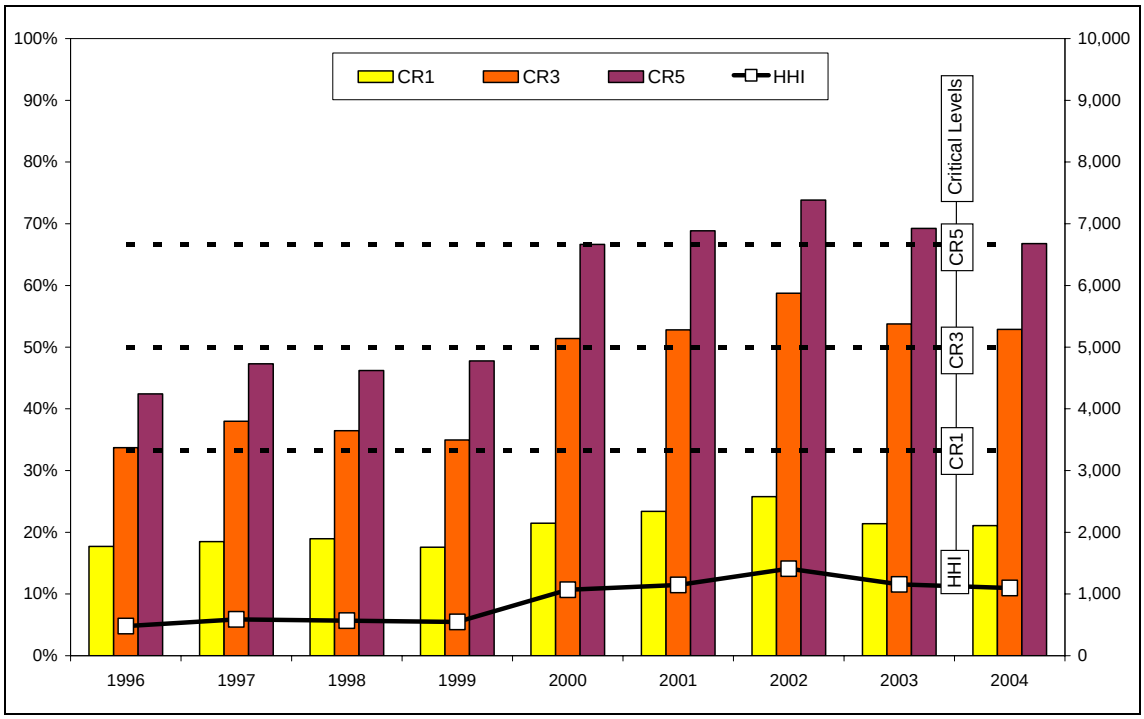
Source Öko-Institut calculations

The major German electricity generators are RWE and E.ON (140 to 150 TWh annually in Germany) and Vattenfall Europe (83 TWh). The power production of EnBW in Germany amounts to 55 TWh.

If a wider view on the relevant markets is taken, the concentration indicators do not today reach the critical levels on the one hand but nevertheless show the same growth trend. In 2000, CR3 and CR5 as well as HHI exceeded the critical levels.

[5] The extreme level of all indicators in 2002 is caused by an exceptional high power production by E.ON in 2002.

Figure 6 *Power Generation Market Concentration in Germany, Austria and Switzerland, 1996-2004*



Source *Öko-Institut calculations*

Besides the large German generators only the Austrian Verbundgesellschaft (30 TWh) and AXPO from Switzerland (31 TWh) play an important role among the major power producers in the region.

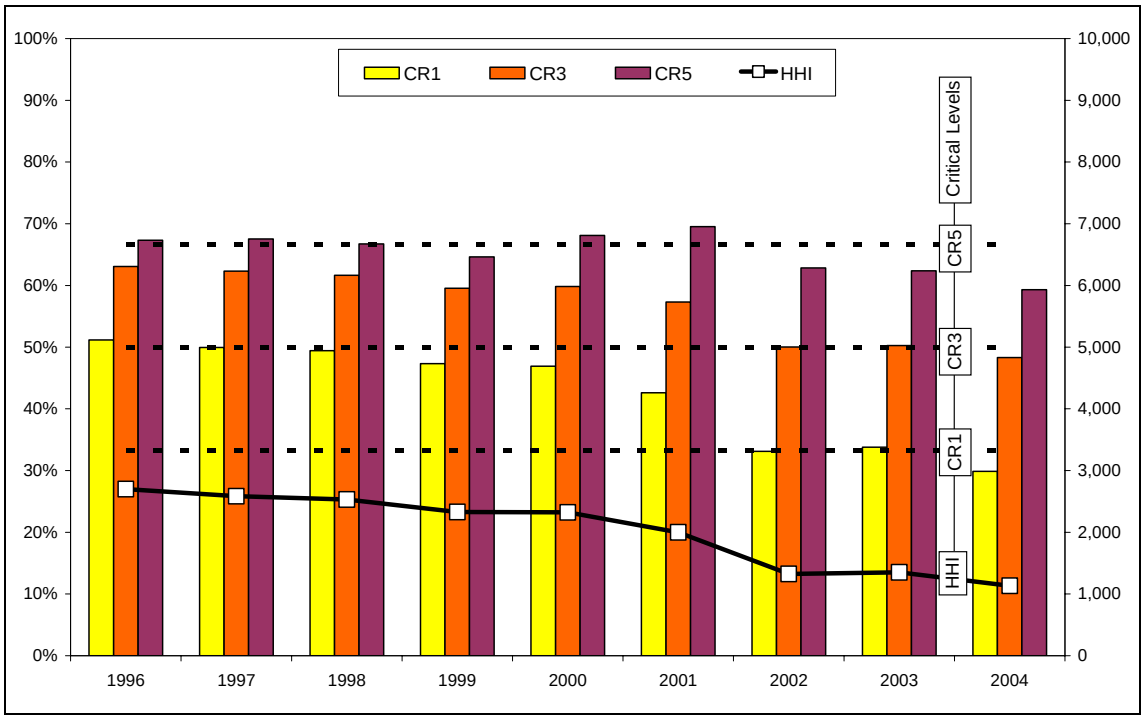
2.6 Italy, Switzerland and Austria

The total electricity generation in the regional market of Italy, Switzerland and Austria was 421 TWh in 2004, of which 286 TWh was produced in Italy. The regional market expanded from 1990 to 2000 by about 36.7 per cent, from 1996 to 2000 by about 23.7 per cent. Power production in Italy accounts for two thirds of the regional market. The increase of power generation in Italy between 1990 and 2000 was slightly above the regional trend but slightly lower from 1996 to 2000.

The concentration indicators show only small changes between 1996 and 2002. Beginning in 2001, all indicators show a significant decrease. In 2004 CR1, CR3 and CR 5 dropped below the critical levels whereas HHI indicates a moderately concentrated power generation market. The main reason for this trend are major disinvestments of the former monopoly ENEL.

However, it should be noted that significant amounts of electricity are exported from France to Italy.

Figure 7 *Power Generation Market Concentration in Italy, Switzerland and Austria, 1996-2004*



Source *Öko-Institut calculations*

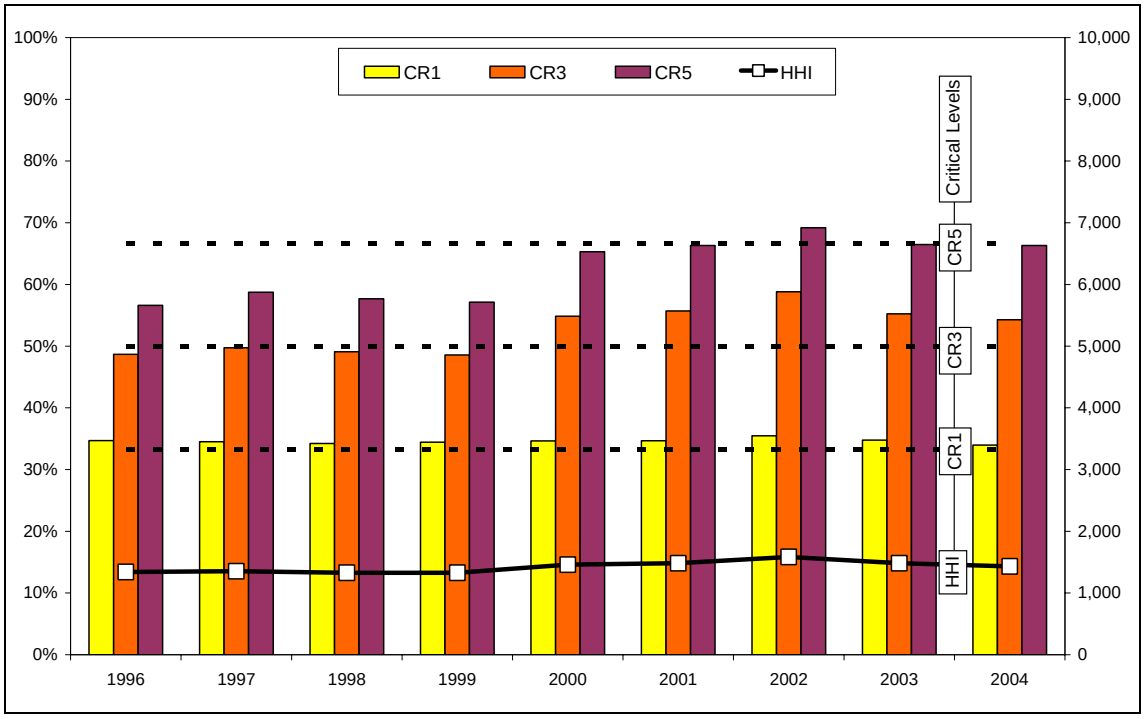
The regional market is dominated by Italy's ENEL with a generation of 126 TWh in 2004. The other large generator in Italy which is undergoing considerable growth is Edison with a 48 TWh production, followed by Edipower (25 TWh) and Endesa Italia (21 TWh).

2.7 A Theoretical Approach: France, Belgium, the Netherlands, Luxembourg, Germany, Switzerland and Austria

The continental power generation market of France, the Benelux countries, Germany, Austria and Switzerland is more of a theoretical approach than a market reality. The generated power in these eight countries amounted to 1,435 TWh in 2004 which is equivalent to a 24.5 per cent increase from 1990 to 2004 and a 13.0 per cent growth between 1996 and 2004. About 78 per cent of the total generated power came from France and Germany.

The concentration indicator CR1 illustrates the dominant role of EdF in the continental power which exceeds the critical level of 33 per cent. In the real market, EdF's power should be even larger because German EnBW is partly owned by EdF which will increase CR1.

Figure 8 *Power Generation Market Concentration in France, Belgium, the Netherlands, Luxembourg, Germany, Switzerland and Austria, 1996-2004*



Source *Öko-Institut calculations*

The increase of CR3 and CR5 underlines the significant influence of the mergers in Germany. As a result, CR3 and CR5 exceeded the critical levels in 2000.

HHI indicates a moderately concentrated market in the upper range of concentration (about 1,500 points) even in this more theoretical case of a large integrated market for power generation in continental Europe.

3 Conclusions

The analysis leads to a clear picture of market concentration in the liberalized power generation markets in Europe. Electricity production in the United Kingdom and in Scandinavia can be characterized as unconcentrated because of the developments in recent years; however, in all other regions market concentration and its trends are critical. In the markets characterized by former centralized state monopolies, the concentration indicators remain very high. The situation in Spain, Portugal and Italy where a slight decrease of market concentration can be observed does not lead to a significantly different situation than in France and Belgium where nearly no changes can be measured. Furthermore, especially in the German market, which is historically characterized by a certain diversity of power generation, the mega mergers pushed the concentration indicators to levels which are more and more critical.

Taking into account the challenge of developing fair, transparent and sustainable energy markets in Europe, several conclusions can be drawn:

- the remaining market concentration in the field of power generation has to be seen as endangering fair, competitive and sustainable energy markets,
- breaking old monopolies and avoiding new concentration trends in the generation sector must be a central issue for competition policy in the energy sector,
- the high levels of market concentration in the generation sector must be compensated for by extremely fair, transparent and coherent rules for third party access,
- additional measures to decrease market concentration in the power generation sector should attract more attention.

Regarding the last issue the following subjects should be addressed

- Strict unbundling of generation, transmission and distribution is a key issue. Further activities on the EU level should tackle ownership unbundling as the medium term target.
- Decentral power generation should receive a premium for long term avoided network costs.
- Additional market distortions (availability of decommissioning funds for activities in the market, fuel cycle cost obligations, liability issues, etc.) between electricity generators should be removed.
- The existing approaches to urged market-dominating companies for to disinvest disinvestments (e.g. in the UK and Italy) or equivalent measures (virtual power plant auctions in Belgium, France etc.) should be strengthened and extended.

Last but not least, the further in-depth evaluation of market concentration in the electricity sector taking place on a regular basis should be seen as a key issue for the future improvement of the internal market for energy.

Table 2 Net Electricity Production in European Countries, 1990-2004

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	TWh														
United Kingdom	299.4	302.7	299.2	304.0	307.9	316.6	329.7	329.1	344.3	351.7	361.0	367.6	370.3	380.4	378.5
Denmark	24.1	34.3	29.1	31.9	37.8	34.5	50.7	41.9	39.2	37.0	34.4	36.1	37.3	43.8	38.4
Sweden	142.9	143.5	142.8	142.4	139.4	144.2	136.6	143.2	153.8	150.8	141.9	157.6	143.2	132.5	148.5
Norway	120.8	110.1	116.5	119.3	112.5	122.5	104.1	111.1	116.1	121.7	142.4	121.2	130.1	106.4	110.5
Finland	51.6	59.2	55.0	58.0	62.2	60.6	66.4	66.2	67.3	66.7	67.3	71.2	71.6	80.4	81.9
Spain	144.6	148.4	150.9	149.4	154.5	159.5	167.4	182.2	187.2	199.2	215.2	228.2	235.3	252.3	268.4
Portugal	27.3	28.7	28.7	29.9	30.2	31.9	33.2	32.9	37.5	41.7	42.2	44.8	44.4	45.4	42.9
France	400.8	434.7	442.7	451.2	455.2	472.1	490.5	481.6	487.7	500.3	516.7	526.8	535.0	542.3	546.7
Belgium	67.2	68.1	68.2	67.2	68.6	70.6	72.4	75.1	79.5	80.9	80.2	76.1	78.1	80.8	82.8
Netherlands	69.5	71.8	74.5	74.0	76.7	77.7	81.8	83.1	87.4	82.9	86.0	89.9	91.9	92.9	94.6
Luxembourg	1.3	1.3	1.2	1.0	1.2	1.2	1.3	1.2	1.3	1.0	1.1	1.2	3.6	3.6	4.0
Germany	510.7	500.5	498.7	488.2	489.3	497.8	515.9	512.8	517.9	518.7	533.6	549.0	536.1	564.7	571.9
Austria	48.9	50.2	50.1	51.5	52.1	55.3	53.4	55.3	56.0	59.0	60.0	60.8	61.1	61.7	71.4
Switzerland	54.0	55.8	57.1	59.7	64.8	61.6	55.0	60.9	60.9	66.7	65.4	70.1	64.9	65.3	63.5
Italia	205.2	210.5	214.4	211.4	219.9	228.9	232.0	238.6	246.3	252.1	263.6	266.0	270.8	280.8	286.3

Sources: Eurostat, UCTE, NORDEL, DTI, AG Energiebilanzen, Öko-Institut calculations