LIBERALISATION VERSUS DECARBONISATION:

THE EFFECTS OF EU RENEWABLES AND INTERNAL ELECTRICITY MARKET POLICIES ON THE EVOLUTION OF FUEL MIXES AND MARKET CONCENTRATION RATES

Frederik Dahlmann: Warwick Business School, University of Warwick, Coventry, UK,
+44 (0)24 7652 2311, Frederik.dahlmann@wbs.ac.uk

ABSTRACT

This paper provides an evaluation of the impact of the related EU internal energy market and renewable energy policies. It addresses the lack of an integrated assessment of EU policies to create an internal energy market and increase renewable energy with respect to the EU electricity sector. Our empirical evidence on EU and member state electricity generation capacity ownership concentration rates provides new insights into the impact of these policies.

Across our sample of European countries and subregions, we witness the installation of increasing rates of renewable energies that are changing the fuel mixes of their respective geographies. Moreover, we observe that generator capacity ownership concentration rates are falling in many European subregions and countries, the number of owner-operators in each market is increasing and thus asset ownership is dispersing. Additionally, the market shares of the ten biggest operators in all countries and subregions are slowly declining over time, again an indication that increasing levels of competition at the generation level are gaining traction. Finally and significantly, we find that increasing rates of renewable energies are playing a major role in contributing to upstream market competition and decreasing asset ownership concentration rates. Our findings suggest that two different sets of policies with aligned but not explicitly cross-referenced aims and objectives are clearly affecting each other in more or less unintended ways.

INTRODUCTION

The European electricity generation sector has been subject to several high-profile EU policy interventions over the last two decades, including policies related to market liberalization, integration (Directives, 1996; 2003; 2009b) and climate change through the promotion of (in particular electricity generated from) renewable energy (Directives, 2001; 2009a).

This paper contributes to the policy evaluations of these legislative initiatives by providing new evidence, from a single data source, on the degree of market concentration in terms of electricity generation capacity across and within European Union (EU) member countries for both traditional fossil fuel and renewable electricity assets. In doing so we assess the interaction of the internal energy market (IEM) and green energy policy initiatives as reflected in the changing market structures and investment choices of European electricity generators and thus contribute to the ongoing debates surrounding the EU IEM integration processes. We also provide new evidence on changes in market concentration, the dominance of national champions (Domanico, 2007) and the longitudinal outcomes in terms of capacity ownership in the electricity sector resulting from the successive EU energy policy moments (Eikeland, 2011; Padgett, 1992; Torriti, 2010).

By making the high degree of relatedness between the IEM and renewables policy processes explicit through an evidenced-based approach, and in light of the originally envisaged IEM completion date of 2014 and resurging debates over new climate change goals to 2030, we seek to provide timely new empirically founded insights for wider policy consideration.

MARKEL LIBERALISATION VERSUS PROMOTING RENEWABLE ENERGIES

The importance and salience of the energy sector within the European project is most directly demonstrated in two of the three founding treaties focusing on the sector and envisioning a common market for coal, nuclear energy and later on other energy sectors (McGowan, 1989). Faced with the aftermath of repeated oil crises, more determined efforts to open national energy markets to European competition only began in 1990 when member states ratified the first directive on energy pricing (Directive, 1990). Since then, a number of energy directives have been passed with the aim to drive convergence towards a single European energy market, increase competition and lower end-consumer prices.

By establishing common rules for the generation, transmission and distribution of electricity the EU tried to create a competitive internal energy market (IEM) (Directive, 1996). Particularly in light of the high energy import dependence affecting economic growth among its member states, the European Commission's earliest efforts were targeted at increasing cross-border energy trade, improving energy security and reducing energy costs (Directive, 2009b; Padgett, 1992).

Moreover, the purpose of liberalising the European electricity market was to provide investors, developers and operators of networks and generation assets with the right financial incentives to introduce consumer choice and develop new business opportunities so as to "end monopolistic pricing, harmonize tariffs, enforce higher levels of efficiency, and turn electricity from a commodity into a market-driven choice of differentiated products and services" (Boscheck, 1994: 111). In that sense, fair competition and ease of market access represented the twin commitments of progressive policy goals for the years to come.

Following the original directive in 1996, two further revisions followed (Directives, 2003; 2009b), which collectively sought to foster and complete competitive electricity markets across the community and to create "a level playing field for all electricity" by 2014.

In parallel to this liberalisation process and driven by the growing scientific consensus and public concerns over the effects of greenhouse gas emissions on the Earth's atmosphere, other EU policy-makers began developing legislative and regulatory responses to 'green' the EU energy sector (Directive, 1993).

Increasingly proposals were drafted and ratified that advocated the use of renewable energies as part of the broader response to climate change by the EU (Directive, 2001). These included the now widely-known '20:20:20 targets': by 2020, the EU was targeting a 20% overall reduction in CO2 emissions from a 2005 baseline, a 20% increase in the share of renewable energies in energy consumption and a 20% increase in energy efficiency (Directive, 2009a).

Our analysis of the relevant policy documents suggests that initial efforts were exclusively directed at creating a competitive internal electricity market through functional and legal unbundling, the

establishment of, and coordination between, similar regulatory bodies, and facilitating grid access and connection.

Implicit in these efforts was largely an understanding that similar types of competitors (i.e., big utilities and perhaps similar entrants) that were operating and emerging at the time would continue to dominate the market. The objective was therefore to enable these firms to compete against each other across the EU on the basis of using largely established fuels (nuclear, gas, coal) and through better integration of wholesale markets.

Interestingly, the first EU directive for electricity liberalization did not appear to prioritise renewable sources. Instead, a commonly-held belief was that liberalisation would actually favour traditional fossil fuelled power assets due to lower financing risks, shorter construction times and better supply characteristics (Jamasb and Pollitt, 2005). There was thus no explicit anticipation that renewable energy firms would one day enter as serious competitors affecting competitiveness and generation capacity ownership concentration.

Meanwhile, however, EU climate change and environmental protection efforts were beginning to influence the growth of renewables, and within the liberalisation stream the link between these two directorate-generals/directives finally starts to emerge in 2009. For instance, the EC argued that “a well-functioning internal market in electricity should provide producers with the appropriate incentives for investing in new power generation, including in electricity from renewable energy sources, paying special attention to the most isolated countries and regions in the Community’s energy market" (Directive 2009b). But even so, the principal explicit policy objective remained to enable and facilitate general grid access and connection, rather than to entertain the more wide-ranging idea of employing renewables for greater market competition.

METHODOLOGY

In this paper we conduct empirical data analyses drawing on data from Platts ‘PowerVision’. PowerVision provides power plant specific data and information on installed and planned generation capacity in the European power sector. Built from the bottom up on detailed granular information, the database comprises over ten years' continuous research by a dedicated product team, which reviews company reports and releases, official government gazettes and filings, tender postings and local press and makes direct enquiries with utilities and developers. Furthermore, the data are cross-referenced to publicly available inventories and benchmarked to aggregate statistics.

For our analysis we draw on all net installed power generation capacities across 24 different European countries between 1996 and 2012. We calculate generation capacity concentration rates for every country both on the basis of the Top 50 and Top 10 Operator Main Holding Companies. Operator Main Holding Companies are those firms that aggregate a diverse portfolio of often limited liability, plant-specific operating units. In many cases these are synonymous with the widely familiar utilities. Generation capacity concentration rates are calculated according to the Herfindahl–Hirschman Index (HHI). The HHI is a measure of the size of firms in relation to the industry and in this study an indicator of the amount of control exercised by individual firms over the stock of generation capacity. It is calculated by summing the squares of the generation capacity shares where generation capacity shares are expressed as percentages of total installed capacity in a particular country and year. Both the HHI of the Top 50 and Top 10 firms were almost identical.

In addition to our summary statistics at the 'EU24' and country levels, we also provide insight into the developments at the subregional level. We adopt six EU subregions, which reflect the composition of the electricity regional initiatives (ERI), launched by the European Regulators Group for Electricity and Gas (ERGEG) in 2006. This is an initiative aimed at bringing together national regulatory authorities (NRAs), transmission system operators (TSOs) and other stakeholders in a voluntary process to advance integration at the subregional level as a step towards the creation of a well-functioning Internal Energy Market (IEM). Through our research we therefore aim to shed further light at the trends occurring within European subregions.

RESULTS

Traditional and Renewable Energy Capacity Trends

We begin our analysis by investigating the traditional and renewable energy capacity trends across Europe (Table 1). Despite the financial crisis and the continuing recession in many European countries (and taking into account nuclear shutdowns and retirement of fossil fuelled plants due to age and environmental legislation), we find strong growth in total installed capacity. In fact, between 1996 and 2012 and across our set of 24 countries, the total capacity installed increased by 375GW or 60% to a total of 629GW. The biggest absolute increase happened in the Central South region (198GW), the biggest percentage increases occurring in Italy (145%), Spain (141%) and Ireland (139%). Meanwhile, the Baltic region was the only to register a decline in installed capacity (-2.7GW), most of which took place in Lithuania and Estonia.

Across the European countries and subregions, our data can also confirm the increasing installation of renewable energies that are changing the fuel mixes of their respective geographies. The rates of change obviously vary between countries and subregions and depend on a number of factors, but against an almost doubling of total installed electricity capacity across our sample of the 'EU24', the ratio of traditional (fossil and nuclear) to renewable energy capacities is slowly shifting in favour of renewables, from 75:25 to 65:35 between 1996 and 2012. The Central West (+19%) and Northern (+17%) subregions witnessed the biggest changes between 1996 and 2012. Denmark, (+33%), Germany (+32%) and Slovakia (+25%) are the leading countries in this shift towards renewables.

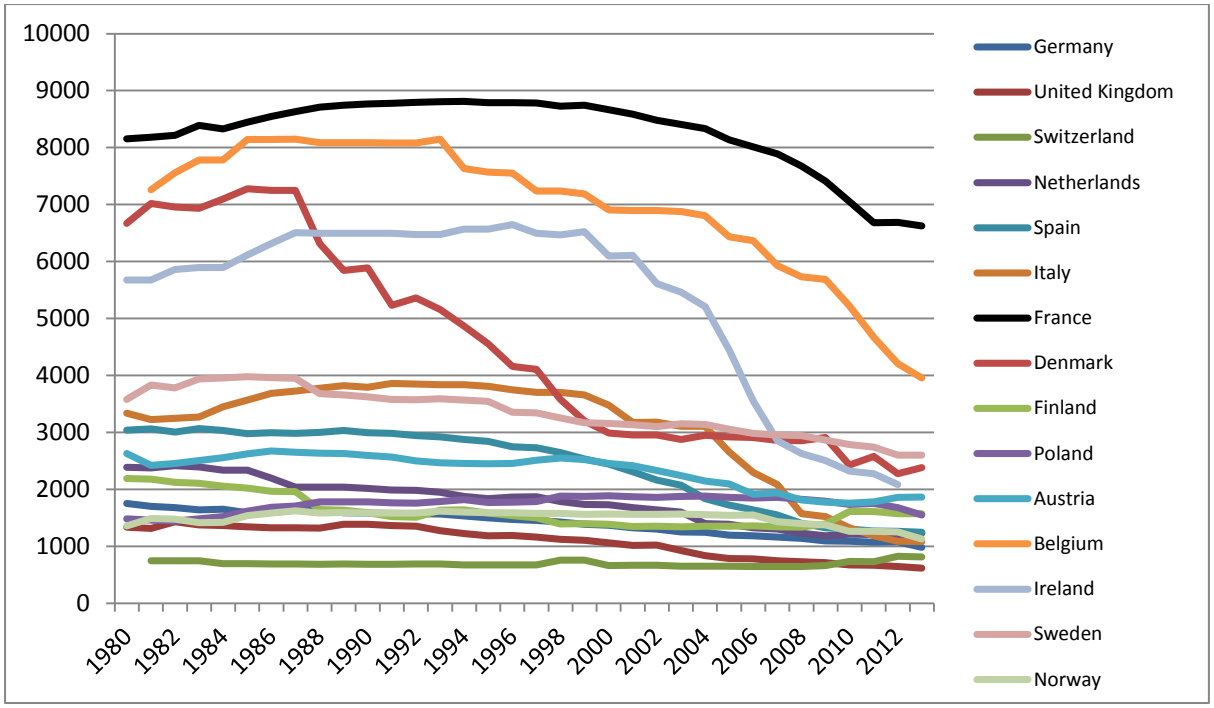
<Table 1 about here>

Generation Capacity Ownership Concentration Trends

Moreover, generator capacity ownership concentration rates are falling across all European regions and countries. Based on our Herfindahl-Hirschman Index of the 50 biggest owner-operators of generation capacity in each country and region, our results suggest that concentration rates are declining, the number of owner-operators is generally increasing and thus asset ownership is increasingly dispersed.

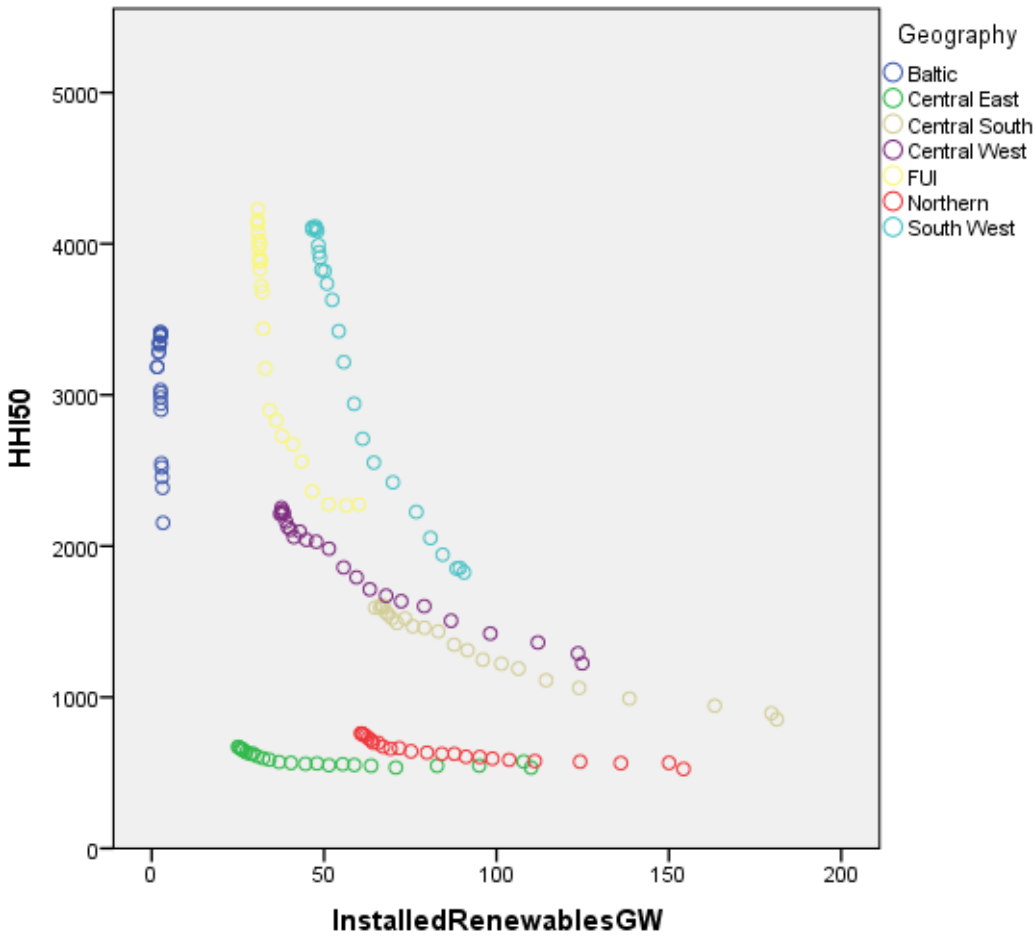
Particularly, we find that the market shares of the ten biggest operators in all countries and regions are declining over time; an indication that increasing levels of competition at the generation level are slowly gaining traction which is consistent with the EU's stated objectives of creating an Internal Electricity Market by enabling grid access to new capacities (Figure 1).

Figure 1: Ownership concentration rates across 15 major European countries



Yet while concentration rates between different countries still vary greatly and remain high in many individual countries, we also observe a very distinctive trend towards convergence at subregional levels. In fact, the most dramatic improvements appear to be happening at subregional level (Figure 2).

Figure 2: Generation capacity ownership concentration (HHi50) vs. installed renewable energy capacities (GW) in the European subregions over time



Stated differently, while policy aims and objectives may have been specified at EU or national levels, the actual focal point and enabler of these trends appears to be the subregional level. Naturally, major differences remain in terms of geographical, economic and political conditions (not least the fact that different subregions contain different numbers of countries), but broadly we suggest that greater harmonisation is occurring through market integration at subregional levels. Since some countries are simultaneously part of several subregions, we surmise it is perhaps exactly this geographical connection between different subregional markets, which seems to act as the key driving force of convergence.

Finally and significantly, we find that increasing rates of renewable energies are playing a major role in contributing to market competition and decreasing asset ownership concentration rates. In extreme cases (for example, in Germany and the Central East subregion) this means that independent renewable energy generators in aggregate are theoretically large enough to exceed a country's biggest utility in terms of installed capacity (Table 2).

Table 2: Subregional Top 10 competitors in 2012

EU 24	Baltic	Central East	Central South
Electricité de France SA	Visagino Atomine Elektrine, UAB	Various Photovoltaic Developers	Electricité de France SA
Various Wind Developers	Latvenergo	Various Wind Developers	Various Photovoltaic Developers
Enel S.p.A.	Eesti Energia AS	RWE AG	Various Wind Developers
Various Photovoltaic Developers	Vilniaus Elektrine AB	E.ON SE	Enel S.p.A.
E.ON SE	Mazeikiu Nafta, AB	Vattenfall AB	E.ON SE
RWE AG	Gazprom	PGE Polska Grupa Energetyczna SA	RWE AG
GDF SUEZ	Vardar AS	CEZ, AS	Vattenfall AB
Vattenfall AB	Achema Group UAB	Energie Baden-Württemberg AG	Public Power Corp. SA
Iberdrola, SA	Rigas Siltums AS	Stadtwerke-Konsortium Rhein-Ruhr	A2A S.p.A.
Gas Natural S.D.G., SA	Fortum Oyj	Verbund - State Ownership	GDF SUEZ
Central West	**FUI**	**Northern**	**South West**
Electricité de France SA	Electricité de France SA	Vattenfall AB	Electricité de France SA
Various Wind Developers	RWE AG	Various Wind Developers	Various Wind Developers
Various Photovoltaic Developers	E.ON SE	Various Photovoltaic Developers	Enel S.p.A.
RWE AG	SSE Plc	E.ON SE	Iberdrola, SA
E.ON SE	GDF SUEZ	RWE AG	Gas Natural S.D.G., SA
GDF SUEZ	Iberdrola, SA	Statkraft SF	Energias de Portugal (EDP)
Vattenfall AB	Various Wind Developers	PGE Polska Grupa Energetyczna SA	GDF SUEZ
Energie Baden-Württemberg AG	Electricity Supply Board	Fortum Oyj	E.ON SE
Stadtwerke-Konsortium Rhein-Ruhr	UK Administrator(s)	Energie Baden-Württemberg AG	Various Photovoltaic Developers
Compagnie Nationale du Rhône, SA	Centrica Plc	Stadtwerke-Konsortium Rhein-Ruhr	Alstom, SA

But also where new renewable capacities still remain small, their existence drives up the total number of generators and as such gradually influences the market dynamics, even before the effects of the unique nature of renewable electricity pricing in the market is taken into account.

We therefore argue that renewables have directly benefitted from the EU's liberalisation directives, which enabled their growth and provided them with access to the national and subregional markets.

Consequently, increasing levels of renewable energies have grown their shares of the total installed capacity that is not owned by the established incumbents and which has led to slowly but broadly decreasing ownership concentration rates.

CONCLUSIONS

In this paper we have sought to answer the question of how the various EU energy-related directives have affected levels and composition of electricity generation capacity concentration across the EU. More specifically, we were interested in the co-evolution of growing levels of renewable capacities and former state monopolies at European, subregional and country levels since market liberalization began.

Across our sample of European countries and subregions, we witness the increasing installation rates of renewable energies that are changing the fuel mixes of the respective geographies. This trend is observable across the board except for Luxembourg, Latvia and Norway, which started with high levels of renewable energies. The rates of change obviously vary between countries and subregions and depend on a number of factors.

This raises the questions to what degree have EU climate change policies contributed to these developments or is this growth in renewable energy entirely driven by national legislation? What we can state is that the widespread growth in renewables across most European countries is consistent with the EU's Directives on climate change and as such suggests that such high-level goals mandated through EU legislation appear to have a significant effect. At the same time, however, we have to acknowledge the differences between renewable generation capacity and output. Given that the EU's 2020 targets refer to output our data cannot verify the extent to which this target is being met.

Our second key finding is that generator capacity ownership concentration rates are falling across all European subregions and countries. This is also exemplified by the observation that the market shares of the ten biggest operators in all countries and subregions are declining over time; again an indication that increasing levels of competition at the generation level are slowly gaining traction. This too is consistent with the EU's stated objectives of creating an Internal Energy Market by increasing the level of competition and providing grid access to new capacities.

The speed with which this transition is occurring is debatable, but based on our observation that many European countries still remain highly dominated by a few large generators, we find that since Domanico's (2007) assessment the progress has been slow. And while there are exceptions (e.g., Germany, Italy, Spain, The Netherlands, UK), largely there has not been a significant and geographically widespread revolution in terms of the ascendance of new pan-European suppliers that would have systematically taken market share and lowered overall concentration of generation capacity.

In fact, our findings suggest that seven major owners of generation capacity persist across our sample of twenty-four European countries, supporting Thomas' (2003) prediction of the emergence of the 'Seven Brothers'. We need to point out, however, that firstly, EDF Energy stands out as being by far the biggest of the 'brothers' (having a market share that is twice as big as the second largest Enel) and secondly, aggregate sums of wind and solar PV could easily represent two new alternative 'firms' in this ranking if they counted as one firm simply by generation technology. Moreover, comparing the seven major firms between 1996 and 2012, we find that except for GDF Suez all other six suppliers lost market share over time in our somewhat artificial EU24 market. Overall, therefore, our assessment is that despite a certain degree of enduring dominance by a limited number of firms, concentration levels in ownership capacity have at least decreased during our period of observation.

More important to emphasise is that while concentration rates between different countries still vary greatly, we also observe a distinctive trend towards convergence at subregional levels. Although concentration levels remain high in many countries, they are significantly lower if a subregional lens is applied and where the most dramatic improvements appear to be happening. If this is indeed the case this may have significant policy implication which we discuss further below.

We argue that the two different sets of policies with aligned but not explicitly cross-referenced aims and objectives are clearly influencing each other in more or less unintended ways. Particularly, each Directorate appeared to be pursuing its own separate agenda without any explicit consideration of potential unintended consequences.

Over time this has led to a situation in which large amounts of 'must-run' renewables are increasingly taking away established utilities' market shares (with significant financial implications). Because of their lower/no marginal costs and preferential grid access treatment (afforded to them through the IEM Directives), renewable energies are now effectively driving wholesale competition in a way that appears to challenge the Commission's original IEM aims. It seems as if market liberalisation and competition as envisaged in the IEM were anticipated to operate and develop within existing market structures (i.e., existing types of fuels and large companies) rather than through the emergence of completely new competitors. As it happens, however, and thanks to the support of the EU's climate change policies, the new market entrants tend to operate with fundamentally different business models that are based on smaller, decentralised assets, with an

intermittent nature of output and which often only feed into the distribution grid rather than being connected to the wholesale markets.

Evidence in this paper suggests that renewables have directly benefitted from the IEM directives, which enabled their growth and provided them with access to the market. Our results support the hypothesis that IEM directives have somewhat unwittingly, and climate change directives more or less directly, encouraged and enabled greater numbers of firms mostly generating renewable energies into the national and subregional markets. In other words, while IEM directives appear not to have been the key driving force behind falling capacity ownership concentration rates (although they have substantially facilitated this trend), improvements in competitiveness on the generation side have resulted from the EU's climate change policies and support for renewable energies in particular. Consequently, increasing levels of renewable energies have grown their shares of the total installed capacity that is not owned by the established incumbents and which has led to slowly but broadly decreasing ownership concentration rates.

Of course, such developments are not uniform across all countries and much depends on national legislation to provide dedicated economic and technical support. Our point here, though, is that there is a general observation of changing fuel mixes which are responsible for greater competitiveness at the upstream generation level. The potential for unintended outcomes due to policy-making and implementation has long been recognised (Wildavsky, 1979) and it is the central thesis of this paper that it is the parallel, largely isolated, development of the EU internal energy market and climate change policies that explains the central role of renewable electricity technologies in changing the market structure of the EU electricity sector, where the internal electricity market policies served only to cement the dominance of the established large electric utilities. The evolution of the electricity sector is thus argued to be an unintended desirable outcome of policy interaction (Merton, 1936).

The limitations of our data do not allow us to investigate changes in vertical integration (e.g., through acquisitions or sale of transmission and distribution assets) or horizontal diversification (e.g., entering gas supply markets) which could feature as part of future research. Also, as our research is based on installed generation capacity we are unable to provide an assessment of market concentration in terms of actual electricity supplied since this would require the analysis of completely different data. Such studies would greatly complement our understanding of the changing market dynamics.

To conclude, we suggest the following policy implications: First, in absence of widely agreed definitions and measures of market concentration, we recommend that future assessments include, if not even focus, on overlapping 'subregional markets', for example, such as those defined by the ERI and as studied in this paper. By actively fostering competition at subregional levels we believe that speedier and more comprehensive levels of electricity market integration may be achieved. Not only should this help with market transparency and technical integration but might also lead to sorely needed consumer price reductions.

Second, we would argue that more needs to be done to fully integrate the IEM and climate change policies with the aim of driving wider liberalisation by enabling even further grid and market access for new entrants. This should encourage companies outside the energy industry, regional authorities and local communities to enter in order to support the growth of real competitors to the seven

brothers. The biggest challenge with all these developments for policy-makers and regulators, however, is to integrate this growing level of decentralised market entrants into a technically and economically functioning wholesale market which delivers low-carbon electricity at economically and socially sustainable levels to the EU's citizens and companies.

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Keyword set: Energy Finance and Investment; Energy Policy; Renewables

Table 1: EU Subregional and Country Electricity Generation Capacity Fuel Mixes and Major Generators' Contributions

EU Region / *Member Country*	Total Installed Capacity (MW)				Installed Traditional[1] Capacity (% of total) : Installed Renewable[2] Capacity (% of total)				Contribution to Total Generation Capacity by the Largest Generator per region/country (% of total)				HHI 50			
	1996	2003	2009	2012	1996	2003	2009	2012	1996	2003	2009	2012	1996	2003	2009	2012
European Union[3]	628,569	698,615	870,838	1,003,926	75:25	72:28	70:30	65:35	19.2	17.6	15.2	13.7	683	588	483	448
Baltic	11,708	11,800	9,044	8,963	80:20	78:22	69:31	65:35	47.6	49.2	31.0	32.9	3,342	3,389	2,548	2,385
Lithuania	6,340	6,587	3,688	4,066	88:12	85:15	71:29	69:31	87.9	88.1	75.9	72.4	7,790	7,807	5,931	5,395
Latvia	2,063	2,106	2,422	2,438	26:74	26:74	36:64	35:65	99.4	98.0	96.2	95.9	9,884	9,608	9,262	9,196
Estonia	3,305	3,107	2,934	2,459	100:0	100:0	94:6	87:13	97.1	96.8	92.3	88.6	9,427	9,380	8,524	7,863
Central East	185,004	205,535	236,513	284,458	85:15	78:22	70:30	62:38	14.3	12.9	11.3	12.3	626	559	535	574
Austria	16,705	17,144	18,393	21,106	33:67	31:69	29:71	30:70	45.7	43.5	37.2	38.9	2,453	2,243	1,773	1,860
Czech Republic	14,405	16,668	17,233	20,141	86:14	88:12	85:15	77:23	74.2	71.2	67.3	61.2	5,583	5,140	4,611	3,893
Germany	106,601	120,024	147,819	184,970	90:10	79:21	68:32	58:42	24.8	21.3	17.5	17.4	1,470	1,249	1,094	1,079
Hungary	7,225	8,596	9,032	9,524	99:1	99:1	93:7	90:10	30.3	29.7	34.0	35.9	2,089	1,864	1,846	1,865
Poland	31,051	32,320	34,578	37,763	94:6	94:6	92:8	86:14	33.7	36.1	35.4	34.6	1,776	1,874	1,788	1,679
Slovakia	6,375	7,823	6,219	7,505	63:17	68:32	60:40	58:42	76.0	76.3	82.8	70.2	5,988	5,973	6,896	5,041
Slovenia	2,642	2,960	3,239	3,449	69:31	90:30	66:34	61:39	70.2	72.4	74.7	70.5	5,578	5,758	6,022	5,393
Central South	301,586	329,062	408,965	499,884	77:23	73:27	70:30	64:36	34.0	31.5	27.4	23.2	1,549	1,347	1,062	894
Austria	16,705	17,144	18,393	21,106	33:67	31:69	29:71	30:70	45.7	43.5	37.2	38.9	2,453	2,243	1,773	1,860
France	105,875	107,933	116,515	124,115	75:25	76:24	73:27	71:29	93.7	91.6	85.9	81.5	8,788	8,409	7,410	6,689
Germany	106,601	120,024	147,819	184,970	90:10	79:21	68:32	58:42	24.8	21.3	17.5	17.4	1,470	1,249	1,094	1,079
Greece	9,026	11,920	14,274	17,169	72:28	71:29	71:29	69:31	99.7	96.9	85.2	69.0	9,938	9,396	7,335	4,953
Italy	60,737	6,9081	108,725	149,075	71:29	71:29	76:24	70:30	58.2	53.1	34.7	27.8	3,746	3,107	1,520	1,087
Slovenia	2,642	2,960	3,239	3,449	69:31	70:30	66:34	61:39	70.2	72.4	74.7	70.5	5,578	5,758	6,022	5,393
Central West	244,467	263,326	307,406	357,863	84:16	79:21	72:28	65:35	41.0	38.1	33.0	28.8	2,125	1,859	1,506	1,290
Belgium	13,383	15,515	19,211	21,550	89:11	90:10	84:16	74:26	86.5	82.2	74.7	63.5	7,554	6,880	5,688	4,209
France	105,875	107,933	116,515	124,115	75:25	76:24	73:27	71:29	93.7	91.6	85.9	81.5	8,788	8,409	7,410	6,689
Germany	106,601	120,024	147,819	184,970	90:10	79:21	68:32	58:42	24.8	21.3	17.5	17.4	1,470	1,249	1,094	1,079
Luxembourg	1,181	1,600	1,608	1,625	3:97	27:73	27:73	27:73	96.4	71.1	70.8	70.0	9,284	5,548	5,494	5,381
The Netherlands	17,427	18,254	22,253	25,603	97:3	93:7	88:12	89:11	26.6	22.6	18.5	19.5	1,863	1,601	1,182	1,163

EU Region / *Member Country*	Total Installed Capacity (MW)				Installed Traditional[1] Capacity (% of total) : Installed Renewable[2] Capacity (% of total)				Contribution to Total Generation Capacity by the Largest Generator per region/country (% of total)				HHI 50			
	1996	2003	2009	2012	1996	2003	2009	2012	1996	2003	2009	2012	1996	2003	2009	2012
FUI	185,492	198,682	236427	254,514	83:17	84:16	82:18	78:22	61.2	57.4	49.1	46.1	3,910	3,438	2,559	2,268
France	105,875	107,933	116,515	124,115	75:25	76:24	73:27	71:29	93.7	91.6	85.9	81.5	8,788	8,409	7,410	6,689
United Kingdom	75,103	85,045	110955	119,624	94:6	94:6	91:9	86:14	19.0	17.8	14.4	13.5	1,191	928	710	643
Ireland	4,514	5,704	8,957	10,775	89:11	87:13	77:23	72:28	78.8	71.6	44.2	39.6	6,649	5,459	2,506	2,081
Northern	223,943	243,515	279,182	326,240	71:29	65:35	60:40	54:46	15.5	14.5	12.7	11.2	699	625	578	566
Norway[3]	28,044	28,587	31359	34,557	0:100	0:100	5:95	8:92	36.3	36.2	33.6	31.9	1,586	1,568	1,372	1,250
Sweden	34,121	34,029	35574	37,878	45:55	43:57	42:58	40:60	53.4	51.4	48.3	45.4	3,352	3,151	2,863	2,597
Finland	14,574	16,251	17167	19,685	69:31	68:32	66:34	62:38	29.4	26.3	26.7	30.5	1,538	1,344	1,390	1,571
Denmark	9,552	12,304	12685	11,387	90:10	69:31	67:33	57:43	63.0	48.0	48.4	37.7	4,156	2,876	2,909	2,274
Germany	106,601	120,024	147,819	184,970	90:10	79:21	68:32	58:42	24.8	21.3	17.5	17.4	1,470	1,249	1,094	1,079
Poland	31,051	32,320	34578	37763	94:6	94:6	92:8	86:14	33.7	36.1	35.4	34.6	1,776	1,874	1,788	1,679
South West	164,195	182,990	242,513	261,577	70:30	70:30	67:33	66:34	60.4	54.0	41.3	38.7	3,943	3,217	2,054	1,855
France	105,875	107,933	116,515	124,115	75:25	76:24	73:27	71:29	93.7	91.6	85.9	81.5	8,788	8,409	7,410	6,689
Portugal	8,729	10,903	16,122	17,867	51:49	58:42	53:47	53:47	87.4	70.5	65.1	58.5	7,692	5,214	4,493	3,663
Spain	49,591	64,154	109,876	119,595	63:37	61:39	62:38	62:38	37.3	31.7	21.5	20.7	2,747	2,069	1,322	1,264

Notes:

1) Traditional fuels include Nuclear, Other, Coal/Cogen, Coal, Boiler/Cogen, Steam Boiler, Combustion Turbine/Cogen, Combined Cycle/Cogen, Combined Cycle, Duct Firing, Combustion Turbine, Reciprocating Engine.
2) Renewable fuels include Geothermal, Hydro, Solar, Wind, Offshore Wind, Waste (includes Biomass), Pumped Storage Hydro.
3) This covers the 24 countries that are included in the subregional groups: Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, United Kingdom.
4) Norway is included as an integral member of the highly integrated Nordic subregional energy market, despite not being an EU member.

Source: Platts PowerVision