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Economic and technological forecasting competencies of German energy companies

Empirical insights from annual reports

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Abstract

Purpose – This paper aims to extend the small body of literature on energy industry transitions on firm level. A growing number of articles shed light on paradigm shifts in the energy industry and the influence of renewable energies on industry structures. In the majority of cases, the authors analyze changes on a global or national level.

Design/methodology/approach – Energy companies' forecasting capabilities are particularly important to enable them to react in time to upcoming changes in industry structures. In this context, we analyze annual reports of German energy companies to evaluate their economic and technological forecasting competencies.

Findings – Big energy providers offer high economic forecasting quality, but seem to be less able to derive valid forecasts in terms of renewable energies from the currently unstable political frameworks. On the contrary, renewable energy companies do not seem to suffer from these difficulties and provide good foresting accuracy in terms of renewable energy development, but show less accurate economic forecasting quality.

Practical implications – Big energy providers need to find the means of responding to the challenges and integrate changing political guidelines and support into their forecasting system. Renewable energy companies, in contrast, should focus on company-level profitability and the respective economic forecasting competencies.

Originality/value – This paper makes a significant contribution to the literature on the subject of energy industry transitions by providing insights from publicly available data on firm level. The findings are highly relevant for managers of the energy industry and policy makers in this field.

Keywords Risk analysis, Forecasting, Renewable energies, Energy industry,
Content analysis of annual reports, Forecasting quality, Group comparison, Transition management

Paper type Research paper

1. Introduction

Recently, a growing number of articles have shed light on paradigm shifts in the energy industry in general and the influence of renewable energies on industry structures in particular. In the majority of cases, the authors analyze recent and future changes on a global or national level, from economic, ecological, political or social perspectives (Amer and Daim, 2010; Czaplicka-Kolarz *et al.*, 2009; Jørgensen, 2005; McDowall, 2012; Pätäri,

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2010; Podobnik, 1999). Amer and Daim (2010), in their work on technology roadmapping, underline the need to identify structural changes and hence strategies and implications on different levels. To contribute to this current stream of research, we aim to extend the current small body of literature which considers energy industry transitions on firm level. Pätäri (2010), for example, identifies success factors on the industry and company levels at the interface of the forest and the energy industry in light of a changing resource base. Moreover, Richter (2012) compares different kinds of business models for utility companies in the light of upcoming renewable energy technologies, and Masini and Menichetti (2013) extend former research by introducing cognitive and behavioral elements when deciding on investments in renewable energies.

But to cope with the challenges of the transition toward a renewable future, energy companies' forecasting capabilities are particularly important to enable them to react in time to upcoming changes in industry structures (Bhattacharyya, 2007). Thus, an analysis on the firm level presupposes the availability of relevant company-specific data. However, the special importance and confidentiality of this information leads to difficulties acquiring such data. One possible way to deal with these difficulties is the utilization of publicly available information. The primary sources of publicly available information on the firm level are annual reports published by companies based on different legal requirements. Annual reports provide information about the development of a corporation in the year under review and a forecast of possible risk factors on company development for the current financial year and beyond (GAS No. 15, 2004). Therefore, analysis and assessment of annual reports and particularly risks stated in the forecasting reports provide an adequate basis for extensive empirical studies. In this context, we decided to focus on the German energy industry and German energy companies because Germany is one of the pioneering countries in promoting and using renewable energies and, in addition, inventor of the "Energiewende", which already has entered global language (Cleff *et al.*, 2009; Dempsey, 2012; Dusonchet and Telaretti, 2010; Eddy, 2012; *The Economist*, 2012).

Within this setting, we aim to address the following research areas:

- At first, we evaluate energy companies' economic forecasting competencies in terms of national, industry and company development.
- In a second step, we analyze energy companies' technological forecasting competencies by testing connections between the stated importance of renewable energies in forecasting reports and the development of companies' capacities for renewables.
- In a third step, we refer to the crude oil price as a factor that influences the transition to renewable energies by testing the connection between companies' oil price forecasts and actual oil price developments (Sick *et al.*, 2013).

The paper is organized as follows: Section 2 provides a brief introduction to the German energy industry and role and the importance of forecasting reports. Section 3 describes the methodology and gives an overview of the empirical database. The main results of the empirical analyses are presented in Section 4 and discussed in Section 5. Finally, concluding remarks, limitations of the study and an outlook on further research are given in Section 6.

2. Conceptual framework

2.1 Theoretical perspectives on companies' risk reporting and forecasting

Risks may arise in all operational areas, functions and processes of a company's business. Strategies concerning risk management have been particularly examined within the boundaries of a company or from an external perspective (LaJili and Zéghal, 2005). However, as part of good corporate governance, companies are increasingly expected to disclose information for stakeholders on their risk management. Stakeholders are thus able to elicit potentially relevant information, which would help to identify possible managerial problems and to assess the effectiveness of the company's management in taking business opportunities and dealing with uncertainties (Linsley and Schrives, 2006; LaJili and Zéghal, 2005). For example, risk disclosure provides guidance in judging management's effectiveness in handling increased market volatility and business uncertainty and the impact on value and growth of the company (Carlin and Mayer, 2003; Linsmeir *et al.*, 2002; Clarkson *et al.*, 1999). In general, risk disclosure enables to reduce information asymmetry between corporate management and stakeholders.

Proprietary costs theory and institutional theory are combined to a comprehensive framework for information disclosure which identifies the determinants of disclosure (Abraham and Shrives, 2014). The proprietary costs theory deals with the costs and benefits of disclosure and suggests that the decision to publish information depends on the consequential costs and perceived benefits of disclosure (Verrecchia, 1983). Within the framework of this theory, costs and benefits of disclosure are supposed to affect the future cash flows of a company and, therefore, the current net present value. As this cost and benefit estimation is accompanied by inherent uncertainty, proprietary costs theory may be complemented by institutional theory. This theoretical framework additionally considers social and political aspects such as a social code of conduct, behavioral norms and regulatory frameworks to decide which information will be published (Di Maggio and Powell, 1983; Oliver, 1991). Companies are facing a wide variety of risks from different dimensions. While operational risk factors tend to be company-specific, other risks (e.g. deriving from cyclical trends, raw material price volatilities or technology trends) affect the entire industry or economy. Referring to the latter type, the extent of impact may differ due to companies' unique characteristics, so that these characteristics and the resulting consequences of the aforementioned risk types should be considered when disclosing risks (Abraham and Shrives, 2014). In summary, the combination of institutional theory and proprietary costs theory enables to integrate company-specific aspects with general industrial and economical risk factors. Information about companies' risk disclosure is available as part of a company's annual report.

2.2 Forecasting reports

The primary sources of publicly available information on the firm level are annual reports published by companies based on different publicity obligations. Annual reports are intended to provide stakeholders, such as shareholders, employees, suppliers, customers and creditors, information about the company's activities, financial performance and outlook. They are available to the public either through the Internet or by request from the investor relations department of the company. In general, an annual report provides information about how a business has performed over the preceding year in terms of its assets, finances and earnings (Williams *et al.*, 2012). Annual reports also contain, apart from the balance sheet, an income statement and

notes to the financial statement, the so-called management report. In accordance with §315 of the German Commercial Code, the management report should provide a concise overview of the performance and current business situation of a company (German Federal Ministry of Justice, 2010). The management report includes management's discussion and analysis of the company's operating results, liquidity and financial position. Part of the management report is also an additional forecasting report. It has to be noted that the term "forecasting report" is not used homogenously throughout companies' annual reports. Frequently encountered alternatives are "forecast report", "development of risks and opportunities" and "risk and opportunities report". This is where the management identifies and discusses risks that may affect the development of the company in the future. The forecasting report contains a description of expected economic developments, an analysis of industry trends and a specific estimate of the development of the corporation. In addition, important company-specific aspects are described and analyzed within this section. This may include raw material prices, future investments or technology trends.

In Germany, there are different legal bases which require the publication of company-specific data. According to the German Commercial Code, corporate enterprises and partnerships are obligated to publish financial information in accordance with company size and legal form (German Federal Ministry of Justice, 2010). Limited liability companies are legally obliged to publish financial information according to §325 of the German Commercial Code. However, regulatory reliefs exist for small- and medium-sized limited liability companies. In these cases, certain information may be illustrated in a condensed form or can be completely omitted according to §326 and §327. General partnerships are obliged to disclose, if their business exceeds specified size classes. In accordance with §1 of the Public Disclosure Act, reporting obligations exist only for large-sized non-incorporated firms and commercial partnerships (German Federal Ministry of Justice, 2011). In addition to the specific obligations applying to enterprises of various legal forms and size classes regarding the publication of their financial information, capital-market-oriented enterprises are subject to particularly high transparency standards. These capital market-driven transparency standards even exceed those of the prescribed publicity requirements. The German Stock Exchange, for example, has established the so-called prime standard with comprehensive disclosure and transparency requirements. Prime standard companies must comply with high international transparency standards such as quarterly reports in German and English, application of international accounting standards (IFRS or USA-GAAP), publication of a corporate calendar, staging of at least one analyst conference per year and *ad hoc* disclosure, also in English (Frankfurt Stock Exchange, 2012).

2.3 The German energy industry

Because of still differing national conditions and regulations, we narrow our analysis to the German national energy industry (Kemfert, 2004; Schumann and Widmaier, 2003). Germany's energy industry is, in our opinion, especially suitable for a firm-level analysis for two reasons. First and foremost, Germany is one of the global pioneers of renewable energy support and usage (Daim *et al.*, 2010; Dusonchet and Telaretti, 2010). In this context, Germany was one of the first countries to enact the phase-out of nuclear power and beyond that is the inventor of the "Energiewende", an extensive governmental program to further promote and support the development of renewable

energies (Federal Ministry of Economics and Technology and Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, 2010; German Federal Ministry of Justice, 1959; Menges, 2003). Despite Germany's politically pioneering role during the past 15 years, the German energy industry itself has – after a long period of standstill – only started to gain momentum during recent years. Since 1935, the German energy industry has been characterized by government-imposed monopolies with assigned areas on the national and the municipal level to ensure a reliable and affordable energy supply (Bower *et al.*, 2001; German Federal Ministry of Justice, 1935; Müller *et al.*, 2007; Müller *et al.*, 2008). Only in 1998, a liberalization of the electricity market was effected by the Energy Industry Act, while a second step of liberalization followed in 2005 (German Federal Ministry of Justice, 1998; German Federal Ministry of Justice, 2005). Taking these developments into account, the energy industry in Germany is on the one hand, sufficiently developed in terms of renewable energies, so that first effects on industry structure can be observed, but on the other hand, it is still in the middle of a transition phase, which makes forecasting even more important (Müller *et al.*, 2008).

The second main reason we focus on Germany is the current industry structure with more than 1,000 energy providers which belong to three different types of energy companies (Müller *et al.*, 2008; Nikogosian and Veith, 2012). First, there are four big energy providers (BEP) which formerly held energy monopolies on the national level and are still responsible for about 85 per cent of electricity generation (Hoffmann, 2007). Their activities cover the whole value chain from energy conversion (e.g. power generation) to wholesale, transmission, distribution and delivery to consumers. while they are still exclusive owners of overland transmission lines (Müller *et al.*, 2008; Nikogosian and Veith, 2012). At the moment, they mainly rely on fossil and nuclear fuels; however, they have also started to invest in renewable energies in recent years. The second largest players in the market are municipal utilities (MU) ("Stadtwerke"), which formerly held energy monopolies on the municipal level. There are about 900 companies, whose range of services usually includes generation and supply of electric and thermal energy and water supply (German Federal Statistical Office, 2012a). Municipal utilities traditionally base their energy supply on fossil fuels as well, but in contrast to the big energy providers, they changed their portfolio at an earlier stage in favor of renewable energies: for example, Stadtwerke München, which launched the first bulk purchase program of PV systems (German Association of Local Utilities, 2008; Haas, 2003). The third group within the German energy industry consists of renewable energy companies (RE) that are exclusively providing renewable energies from hydro, solar or wind power and biomass (German Energy Agency, 2011).

3. Data and methodology

As introduced in the former section, we use data from forecasting reports of German energy companies. To do so, we form three groups, according to the described company types: big energy providers, municipal utilities and renewable energy companies. As far as big energy providers are concerned, we include all big German energy providers in the analysis, namely, E.ON, EnBW and RWE (Table I). As all companies are listed on the stock exchange, detailed annual reports are publicly available. The fourth big energy provider in Germany, Vattenfall, is a Swedish company and therefore not part of our analysis. As there are more than 900 municipal utilities companies in Germany, we first limit our selection to municipal utilities in German cities with more than 250,000

Big energy providers	Municipal utilities	Renewable energies	
E.ON	Stadtwerke Bochum	2G energy	Biogas
EnBW	DREWAS Stadtwerke Dresden	AGO Energie und Anlagen	All
RWE	DVV Stadtwerke Duisburg	CONERGY	Solar
	Stadtwerke Düsseldorf	Energiekontor	Wind
	Stadtwerke Frankfurt	EnviTec Biogas	Biogas
	Enercity Stadtwerke Hannover	KTG Energie	Biogas
	RheinEnergie (Köln)	Phoenix Solar	Solar
	ESWE Wiesbaden	PNE WIND	Wind
		S.A.G. Solarstrom	Solar
		SolarWorld	Solar

Table I. Sample of German energy companies

inhabitants, which adds up to a total of 28 companies. In a second step, we select eight companies by data availability criteria, as municipal utilities are mostly limited liability companies with limited reporting requirements: Stadtwerke Bochum, DREWAS Stadtwerke Dresden, DVV Stadtwerke Duisburg, Stadtwerke Düsseldorf, Stadtwerke Frankfurt, Enercity Stadtwerke Hannover, RheinEnergie and ESWE Wiesbaden. In terms of renewable energy companies, we focus on companies which are listed on a stock exchange because of the underlying publication requirements. For this purpose, we search two databases: DAFNE by Bureau van Dijk, which contains financial and other information of German companies, and Thomson Reuters Datastream, which offers a national industry search. In DAFNE, we select publicly listed German energy providers, and in Datastream, we select German publicly listed companies in the electricity sector. In a next step, we then identify all of these companies that are dedicated to the provision of renewable energies, which sum up to a total of ten: 2G energy, AGO Energie und Anlagen, CONERGY, Energiekontor, EnviTec Biogas, KTG Energie, Phoenix Solar, PNE WIND, S.A.G. Solarstrom and SolarWorld.

On the basis of this sample, we collect the following data from each company's forecasting reports in the period from 2007 to 2011:

- assessment of economic development on national, industry and company levels;
- assessment of the importance of renewable energies for the company; and
- assessment of the price development of crude oil as reference for the price development of further energy raw materials.

The assessments are rated on a three-point ordinal scale: increasing, consistent or decreasing.

To evaluate the quality of companies' forecasting reports, we compare the companies' assessments with relevant indicators. For economic development on the national level, we use German GDP growth as the indicator, while the industry level is indicated by sales growth of German electricity companies. The data are provided by the German Federal Statistical Office and industry reports (Fischer | Bussmann | Konrad, 2012; German Federal Statistical Office, 2012b, 2012c). On the company level, we use EBIT margin as reference for business profitability. The data come from companies' annual reports. The importance of renewable energies is controlled by growth of installed capacities of renewables in Germany. Capacity data are provided by the Renewables

Database of the International Energy Agency (IEA, 2012). Assessment of the crude oil price can be easily controlled by annual growth rates of the crude oil price, which are taken from Thomson Reuters Datastream.

To allow for better comparability, the indicators are then transformed into the abovementioned three-point ordinal scale. The transformation scheme from metric growth rates to ordinal categories is designed as follows (Table II). At first, we compute mean and standard deviation of the time series, except EBIT margin of the past 20 years from 1992 to 2011 (Table A1 in Appendix). For EBIT margin, we use the company's EBIT itself as the basic indicator. If we assume a normal distribution for the time series, 50 per cent of the data points are within a range of 67.5 per cent of standard deviation from the mean. Consequently, increasing is attributed to values which are higher than the upper bound of mean plus 67.5 per cent of standard deviation. Decreasing in contrast is attributed to values which are below the lower bound of mean minus 67.5 per cent of standard deviation. Consistency is then attributed to all values between the lower and upper bounds. In a second step, we are then able to compare companies' assessments of economic development on the national, industry and firm levels, as well as of the importance of renewable energies and oil price developments with the respective indicators. On this basis, we highlight whether a company's forecast corresponds to the indicator or whether the company has under- or overestimated the development. To check for differences in forecasting quality between big energy providers, municipal utilities and renewable energy companies, we use a Bayesian approach. Based on a beta-binomial model, we investigate differences in hit ratios by pairwise comparisons of big energy providers, municipal utilities and renewable energy companies (Gelman *et al.*, 2014; Lee, 2012).

4. Results

The company-specific assessments of economic development on national, industry and company levels; of the importance of renewable energy; and of the price development of crude oil are compared with relevant indicators in the following: at first, the forecasted development of the general economic situation is shown in Table III. German GDP growth as an indicator for the economic development on the national level was consistent in 2007, decreasing in 2008, increasing in 2009 and 2010 and consistent again in 2011. A comparison of real GDP development with the individual companies' assessments from 2007 until 2011 shows an average hit ratio of 59.3 per cent. In 28.3 per cent of the cases, the represented companies underestimated the actual development, whereas in 12.4 per cent of the cases, they overestimated it. Pairwise comparisons of company types reveal that there is a possibility of 89.1 per cent and 88.1 per cent, respectively, that big energy providers have a higher hit rate than municipal utilities and renewable energy companies. When looking at the single years, it can be seen that the hit ratio was low in 2009 and 2010. In both years, the real economic development was

Table II.
Transformation scheme of indicators to ordinal categories

Ordinal	Metric
Increasing	$x >$ mean + 0.675 × standard deviation
Consistent	mean − 0.675 * standard deviation $\leq x \leq$ mean + 0.675 × standard deviation
Decreasing	$x <$ mean − 0.675 × standard deviation

Company/Forecasting quality	2007	2008	2009	2010	2011
eon	0	−	0	0	0
RWE	0	−	0	+	+
EnBW	0	−	+	+	0
Hit (%)	**100**	**100**	**33**	**67**	**67**
Underestimated (%)	**0**	**0**	**67**	**33**	**0**
Overestimated (%)	**0**	**0**	**0**	**0**	**33**
2G energy	+	−	n/a	+	0
AGO Energie + Anlagen	0	−	−	0	+
CONERGY	+	−	0	0	0
Energiekontor	0	−	0	0	0
EnviTec Biogas	n/a	−	0	+	0
KTG Energie	n/a	n/a	+	+	0
Phoenix Solar	n/a	−	0	0	0
PNE WIND	n/a	0	0	n/a	0
S.A.G. Solarstrom	0	−	0	0	0
SolarWorld	+	−	0	0	0
Hit (%)	**50**	**89**	**11**	**33**	**90**
Underestimated (%)	**0**	**0**	**89**	**67**	**0**
Overestimated (%)	**50**	**11**	**0**	**0**	**10**
Stadtwerke Düsseldorf	n/a	−	0	+	0
DVV Stadtwerke Duisburg	n/a	n/a	0	0	n/a
Stadtwerke Bochum	n/a	0	0	+	0
DREWAS Stadtwerke Dresden	n/a	−	n/a	n/a	n/a
Enercity Stadtwerke Hannover	n/a	n/a	0	0	0
ESWE Wiesbaden	n/a	−	0	+	+
RheinEnergie	n/a	−	0	+	n/a
Stadtwerke Frankfurt Holding	n/a	n/a	n/a	0	0
Hit (%)	n/a	**80**	**0**	**57**	**80**
Underestimated (%)	n/a	**0**	**100**	**43**	**0**
Overestimated (%)	n/a	**20**	**0**	**0**	**20**
Indicator (German GDP growth) (%)	**0**	−	**+**	**+**	**0**
Hit (%)	**67**	**88**	**11**	**47**	**83**
Underestimated (%)	**0**	**0**	**89**	**53**	**0**
Overestimated (%)	**33**	**12**	**0**	**0**	**17**

Notes: p (hit rate$_{(BEP)}$ > hit rate$_{(RE)}$) = 0.881; p (hit rate$_{(BEP)}$ > hit rate$_{(MU)}$) = 0.891; p (hit rate$_{(MU)}$ > hit rate$_{(RE)}$) = 0.390; Bold data: Forecasting quality and indicator

Table III.
Forecasting quality of the German economic development

considerably underestimated. In 2007, 2008 and 2011, in contrast, we observe overestimation of economic development.

Table IV illustrates the forecasted development of the German energy industry subdivided into five periods and three groups of energy companies. The indicator of energy industry development (sales growth of German electricity companies) was increasing in 2007, consistent from 2008 to 2010 and decreasing in 2011. In 13.7 per cent of the cases, companies underestimated the actual development, whereas in 37.9 per cent of the cases, they overestimated it. Group analysis shows a heterogeneous picture, in particular in the period from 2007 to 2010, forecasting quality varied according to group membership. The hit ratio of the three big energy providers ranges between 67 per cent

Company/Forecasting quality	2007	2008	2009	2010	2011
Eon	0	0	0	0	–
EnBW	0	0	0	–	0
RWE	0	0	+	0	0
Hit (%)	**0**	**100**	**67**	**67**	**33**
Underestimated (%)	**100**	**0**	**0**	**33**	**0**
Overestimated (%)	**0**	**0**	**33**	**0**	**67**
2G energy	0	+	+	+	0
AGO Energie + Anlagen	+	0	0	0	+
CONERGY	+	0	+	0	0
Energiekontor	+	+	0	+	+
EnviTec Biogas	+	+	0	+	–
KTG Energie	+	+	+	+	+
Phoenix Solar	+	0	+	0	0
PNE WIND	+	+	+	+	+
S.A.G. Solarstrom	+	+	+	+	0
SolarWorld	+	+	+	+	0
Hit (%)	**90**	**30**	**30**	**30**	**10**
Underestimated (%)	**10**	**0**	**0**	**0**	**0**
Overestimated (%)	**0**	**70**	**70**	**70**	**90**
Stadtwerke Düsseldorf	n/a	–	0	0	0
DVV Stadtwerke Duisburg	n/a	n/a	0	0	0
Stadtwerke Bochum	0	0	n/a	0	–
DREWAS Stadtwerke Dresden	0	0	0	0	0
Enercity Stadtwerke Hannover	n/a	n/a	0	0	–
ESWE Wiesbaden	n/a	–	0	0	0
RheinEnergie	0	–	0	0	n/a
Stadtwerke Frankfurt Holding	0	n/a	n/a	0	–
Hit (%)	**0**	**40**	**100**	**100**	**43**
Underestimated (%)	**100**	**60**	**0**	**0**	**0**
Overestimated (%)	**0**	**0**	**0**	**0**	**57**
Indicator (sales growth) (%)	**+**	**0**	**0**	**0**	–
Total hit (%)	**53**	**44**	**58**	**62**	**25**
Total underestimated (%)	**47**	**17**	**0**	**5**	**0**
Total overestimated (%)	**0**	**39**	**42**	**33**	**75**

Table IV.
Forecasting quality of the German energy industry development

Notes: p (hit rate$_{(BEP)}$ > hit rate$_{(RE)}$) = 0.853; p (hit rate$_{(BEP)}$ > hit rate$_{(MU)}$) = 0.261; p (hit rate$_{(MU)}$ > hit rate$_{(RE)}$) = 0.985; Bold data: Forecasting quality and indicator

and 100 per cent from 2008 to 2010. In 2007, all companies in the group underestimated industry development. In contrast, 70 per cent of renewable energy companies overestimated the development of the energy industry in the period from 2008 to 2010. The group of municipal utilities demonstrated a good accuracy in 2009 and 2010. In the period 2007-2008, however, municipal utilities underestimated industry development. In summary, big energy providers and municipal utilities show better hit rates than renewable energy companies, with a possibility of 85.3 per cent and 98.5 per cent, respectively.

The forecasted individual profitability and the real development of a company are compared in Table V. Having a closer look at the individual EBIT margins, it should be

Company/Forecasting quality	2007	2008	2009	2010	2011	Mean
eon	+	0	0	0	+	
EBIT margin **(%)**	13.4	11.4	11.8	10.2	4.8	10.8
RWE	+	+	+	−	0	
EBIT margin **(%)**	15.3	13.9	14.9	14.4	11.2	13.9
EnBW	+	+	0	−	−	
EBIT margin **(%)**	10.6	9.0	12.1	12.1	3.6	9.8
Hit (%)	**100**	**0**	**100**	**33**	**66**	
Underestimated (%)	**0**	**0**	**0**	**33**	**0**	
Overestimated (%)	**0**	**100**	**0**	**33**	**33**	
AGO Energie + Anlagen	+	+	+	+	+	
EBIT margin **(%)**	0.3	−4.0	1.7	0.0	−5.7	−0.8
CONERGY	0	−	+	+	0	
EBIT margin **(%)**	−14.5	−39.6	−23.5	−22.2	−22.4	−21.3
Energiekontor	+	0	+	+	+	
EBIT margin **(%)**	−33.7	−16.0	−21.0	−99.5	40.1	−23.0
EnviTec Biogas	+	+	n/a	+	0	
EBIT margin **(%)**	14.5	8.1	1.0	−4.2	4.0	6.3
Phoenix Solar	+	+	+	0	0	
EBIT margin **(%)**	3.6	7.9	2.5	5.6	−19.0	0.7
PNE WIND	+	+	+	+	+	
EBIT margin **(%)**	1.7	−91.1	1.6	5.5	9.2	−17.2
S.A.G. Solarstrom	+	+	+	+	0	
EBIT margin **(%)**	−91.6	6.1	559.2	−134.5	22.4	45.3
SolarWorld	+	+	+	+	0	
EBIT margin **(%)**	9.1	12.4	4.0	9.3	−5.1	6.3
Hit (%)	**17**	**25**	**38**	**0**	**25**	
Underestimated (%)	**0**	**0**	**13**	**0**	**0**	
Overestimated (%)	**83**	**75**	**50**	**100**	**75**	
Stadtwerke Düsseldorf	n/a	0	0	0	0	
EBIT margin **(%)**	5.9	4.6	4.6	5.6	6.9	5.8
DVV Stadtwerke Duisburg	n/a	n/a	+	+	+	
EBIT margin **(%)**	n/a	n/a	2.9	3.4	1.7	2.7
Stadtwerke Bochum	0	+	0	−	−	
EBIT margin **(%)**	4.3	3.0	3.1	11.3	1.7	4.9
DREWAS Stadtwerke Dresden	0	−	0	0	−	
EBIT margin **(%)**	10.7	9.6	10.8	11.7	12.9	11.4
Enercity Stadtwerke Hannover	n/a	n/a	−	0	0	
EBIT margin **(%)**	6.6	4.3	6.9	6.0	5.6	6.0
ESWE Wiesbaden	n/a	−	0	0	0	
EBIT margin **(%)**	7.8	10.8	9.8	11.8	8.2	9.4
RheinEnergie	−	−	−	−	n/a	
EBIT margin **(%)**	6.9	4.8	11.0	10.2	10.9	8.2
Stadtwerke Frankfurt Holding	0	0	0	0	0	
EBIT margin **(%)**	8.1	5.7	4.5	5.9	4.5	5.6
Hit (%)	**0**	**100**	**17**	**50**	**25**	
Underestimated (%)	**100**	**0**	**33**	**50**	**38**	
Overestimated (%)	**0**	**0**	**50**	**0**	**38**	

Notes: p (hit rate$_{(BEP)}$ > hit rate$_{(RE)}$) = 0.996; p (hit rate$_{(BEP)}$ > hit rate$_{(MU)}$) = 0.901; p (hit rate$_{(MU)}$ > hit rate$_{(RE)}$) = 0.945; Bold data: Forecasting quality and indicator

Table V.
Forecasting quality of German energy company development

noted first that there are substantial discrepancies between the average EBIT margins of the three groups. With 11.5 per cent, the highest average EBIT margin can be observed in the first group, which includes the three big energy providers. An explicitly lower EBIT margin of 6.9 per cent was observed in the last group of municipal utilities.

Further differences between the three groups become evident by involving the time component in the analyses. The first group is characterized by stable EBIT margins in the period from 2006 to 2010. However, a sharp decline in margins occurred in the year 2011. Especially in the case of E.ON and EnBW, the margins were reduced by 53 per cent and 71 per cent, respectively. The group of municipal utilities also demonstrated stable EBIT margins at medium levels during the entire period. Renewable energy companies are characterized by very volatile EBIT margins ranging from −23.0 per cent to 45.3 per cent, on average.

The comparison of individual EBIT margins as an indicator of the companies' economic development and the forecasted individual profitability shows as well that there are differences between the three groups. The first group of big energy providers demonstrated a good accuracy in 2007, 2009 and 2011. However, the hit ratio of the three big energy providers was extremely low in 2008, when all three companies overestimated profitability. Renewable energy companies show lower hit ratios between 0 per cent in 2010 and 38 per cent in 2009 and tend to overestimate economic development on firm level. In contrast to the first two groups, municipal utilities are characterized by good hit ratios and a tendency to underestimate economic development. In summary, big energy providers show better hit rates than municipal utilities and renewable energy companies, with a probability of 90.1 per cent and 99.6 per cent, respectively. Moreover, municipal utilities tend to have better hit rates than renewable energy companies with a possibility of 94.5 per cent.

The connection between stated importance of renewable energies in the respective forecasting reports and actual developments of renewable energy capacities of the companies is depicted in Table VI. As we were not able to find any reliable data on renewables capacities of municipal utilities, we restrict the analysis to big energy providers and renewable energy companies. With regard to the three big German energy providers, it can be clearly seen that they systematically overestimate the importance of renewable energies. Overestimation in this context means that all big energy providers state a higher importance of renewable energies in their forecasting reports than the development of renewable energy capacities is able to confirm. Although E.ON and RWE consistently forecast an increasing importance of renewable energies for the company, the development of their renewable energy capacities is either consistent or decreasing. EnBW, however, the German energy provider with the highest share in nuclear power generation, forecasts a consistent importance of renewable energies. The only exception was the year 2010 with an increasing importance. But in contrast to the mixed picture with respect to E.ON's and RWE's renewable energy capacities, the capacities of EnBW show a consistently decreasing trend.

The results in terms of renewable energy companies, on the contrary, do not present a uniform picture. While EnviTec Biogas and S.A.G. Solarstrom are continuously on the right track with their forecasts, KTG Energie systematically underestimates and SolarWorld mostly overestimates the importance of renewable energies. On the other hand, Energiekontor and PNE Wind show mixed results. Throughout the years, forecasting accuracy has decreased among renewable energy companies. While the hit

Company/Forecasting quality	2007 F	2007 I	2008 F	2008 I	2009 F	2009 I	2010 F	2010 I	2011 F	2011 I
E.ON	n/a	n/a	n/a	n/a	+	−	+	0	+	−
RWE	+	0	+	0	+	0	+	−	+	0
EnBW	0	−	0	−	0	−	+	−	0	−
Hit (%)		0		0		0		0		0
Underestimated (%)		0		0		0		0		0
Overestimated (%)		100		100		100		100		100
Energiekontor	0	0	0	0	0	−	+	0	0	+
EnviTec Biogas	+	+	+	+	+	+	+	+	+	+
KTG Energie	+	n/a	0	+	0	+	0	+	0	+
PNE WIND	0	n/a	0	+	0	+	0	−	0	−
S.A.G. Solarstrom	+	+	+	+	+	+	+	+	+	+
SolarWorld	0	−	0	−	0	+	0	−	0	−
Hit (%)		75		50		33		33		33
Underestimated (%)		0		33		50		17		33
Overestimated (%)		25		17		17		50		33

Notes: F = Forecast; I = Indicator; p (hit rate$_{(RE)}$ > hit rate$_{(BEP)}$) = 0.998; Bold data: Forecasting quality and indicator

Table VI.
Forecasting quality of the importance of renewable energies

ratio was at 75 per cent in 2007 and 50 per cent in 2008, it declined to 33 per cent in the period from 2009 to 2011. In terms of over- or underestimation of the importance of renewables, a clear trend cannot be identified over the years. In summary, renewable energy companies provide better hit ratios than big energy providers with a possibility of 99.8 per cent.

Looking at renewable energy capacities of the big energy providers in absolute numbers in Figure 1, it becomes clear that only RWE shows an increasing trend with an average annual growth rate of 9.6 per cent, whereas capacities of E.ON and EnBW have been slightly decreasing over the past five years with average annual growth rates of −4.6 per cent and −2.2 per cent, respectively.

With regard to capacity development of renewable energy companies, EnviTec Biogas and S.A.G. Solarstrom – the companies with the best forecasting quality – reach the highest average annual growth rates with 42.7 per cent and 46.9 per cent, respectively (Figure 2). KTG Energie – the company that systematically underestimated the importance of renewables – exceeds the German average with an annual growth rate of 35.9 per cent. The three remaining companies (Energiekontor, PNE Wind and SolarWorld), that rather tend to overestimate the importance of renewables, reach much lower growth rates of 12.6 6.1 and 7.5 per cent, respectively.

Table VII contains the comparison of companies' oil price forecasts with actual oil price developments for big energy providers and renewable energy companies. Analogous to the assessment of the importance of renewables, municipal utilities do not provide sufficient information and are therefore excluded from this part of the analysis. Big energy providers and renewable energy companies show volatile hit rates from 2007 to 2011, ranging in both groups from 0 to 100 per cent with a tendency to overestimate price developments. Analyzing forecasting quality over years instead of company types, the following results become apparent. In 2007, all

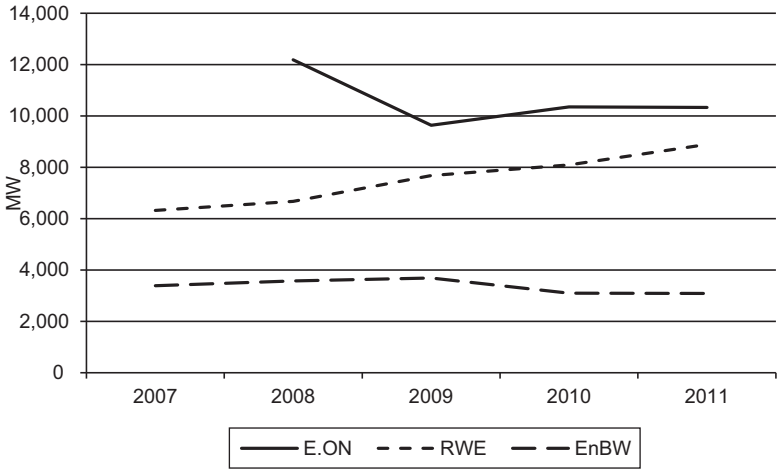


Figure 1.
Renewable energy capacities of big German energy providers

Source: Annual reports of the companies

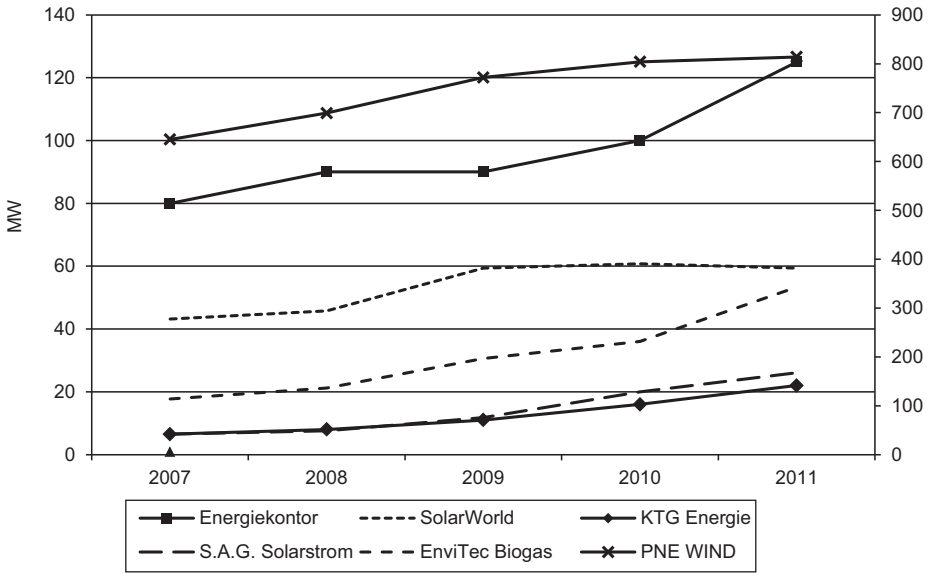


Figure 2.
Renewable energy capacities of renewable energy companies

Note: The capacities of PNE Wind and EnviTEc Biogas are displayed on the right axis

energy companies assumed the oil price to be rising, while in 2008, all companies except EnviTec Biogas overestimated oil price developments in 2008. In the following years 2009 and 2010, the majority of companies correctly expected the oil price to rise again; only RWE underestimated the development and assumed

Company/Forecasting quality	2007	2008	2009	2010	2011
E.ON	+	+	n/a	+	+
RWE	+	0	0	+	0
EnBW	+	+	+	+	0
Oil price development	+	−	+	0	0
Hit (%)	100	0	50	0	67
Underestimated (%)	0	0	50	0	0
Overestimated (%)	0	100	0	100	33
Energiekontor	+	n/a	n/a	+	+
EnviTec Biogas	+	−	+	n/a	n/a
KTG Energie	n/a	n/a	n/a	n/a	n/a
PNE WIND	n/a	+	+	n/a	n/a
S.A.G. Solarstrom	n/a	n/a	n/a	n/a	n/a
SolarWorld	+	+	+	+	+
Oil price development	+	−	+	0	0
Hit (%)	100	33	100	0	0
Underestimated (%)	0	0	0	0	0
Overestimated (%)	0	67	0	100	100

Note: p (hit rate$_{(BEP)}$ > hit rate$_{(RE)}$) = 0.417; Bold data: Forecasting quality and indicator

Table VII. Forecasting quality of oil prices

consistent prices. In 2011 in contrast, the oil price followed a rather lateral trend which was forecasted only by RWE and EnBW in 2011, while all other companies expected rising prices in both years.

5. Discussion

After having presented the results of our analysis of forecasting quality, we will provide a more detailed look into possible reasons for and connections between the described findings. Starting with economic development on national level, the analysis reveals that big energy providers tend to show better forecasting accuracy than municipal utilities and renewable energy companies. Moreover, we can detect differences between different years, as 2009 and 2010 show lower hit ratios throughout all groups. Probably the consequences of the global financial crises were overestimated from 2009 to 2010, whereas GDP as a measure for real economic development on national level recovered more quickly than energy companies expected (Conergy, 2008; RWE, 2011; SolarWorld, 2008; Stadtwerke Düsseldorf, 2009). So it might be argued that forecasting quality of economic development on national level, at least in the presence of external shocks like a global financial crisis, is dependent on company type and the respective year(s).

With regard to economic development on industry level, big energy providers and municipal utilities show better forecasting accuracy than renewable energy companies. It is noticeable that the average forecasting hit ratio of 48.4 per cent on the industry level was considerably lower than the average hit ratio on the national level. Probably, forecasting on the industry level involves a greater degree of uncertainty than on the national level. This might be due to the dependency of the energy industry on regulations on national and European level, which have major influence on industry development and structure, e.g. the Energy Industry Act or the Renewable Energy Act mentioned in Section 2.3. This can also be seen in the fact that, in contrast to the previous

analyses of national economic development, the lowest forecasting quality is noted in 2011. In this year, German nuclear power phase-out in the aftermath of Fukushima and an increasing pressure on prices in the solar industry converged (Hayashi and Hughes, 2013; Huenteler *et al.*, 2012; Nestle, 2012). At least the nuclear power phase-out was quite difficult to foresee for German energy companies and is thus categorized as external or regulatory risk factor in various annual reports of the year 2011 (EnBW, 2011; E.ON, 2007; RWE, 2011).

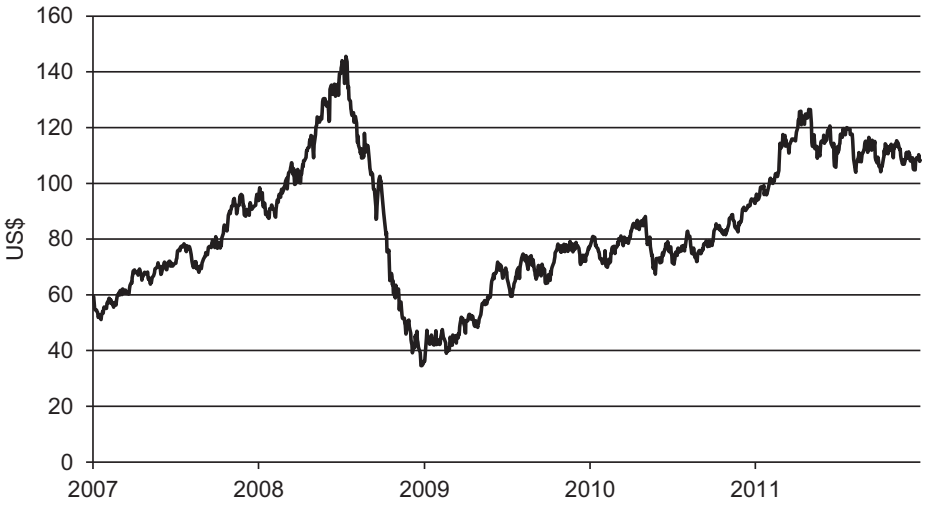
Big energy providers show stable EBIT margins until 2010 and a sharp decline in the year 2011, particularly concerning E.ON and EnBW. The considerable decline in margins presumably resulted from the German nuclear power phase-out in June 2011 (German Federal Ministry of Justice, 2011). As a result, nuclear power plants – exclusively owned by big energy providers and ensuring high margins – must be switched off, so that EBIT margins dropped substantially (EnBW, 2011; E.ON, 2011; RWE, 2011). But nonetheless, big energy providers show a better forecasting accuracy than municipal utilities and renewable energy companies, while, at the same time, municipal utilities tend to have a better forecasting accuracy than renewable energy companies. In this case, municipal utilities show good hit ratios and a tendency to underestimate economic development. This may be caused by the fact that municipal utilities are often publicly owned and, therefore, do not pursue profits. In addition, this is probably an indication that municipal utilities pursue a conservative strategy and risk management during the analyzed period. Of particular note in terms of economic development on firm level is the negative average EBIT margin of −0.5 per cent in the group of renewable energy companies. This is the result of an extremely intense competition and price pressure in the renewable energy market and especially in the solar industry (Huenteler *et al.*, 2012). EBIT margins in the group of renewable energy companies are specified by a very high level of variance and ranged from 135 per cent to 559 per cent. In addition to intense market competition, this is presumably also due to the limited size of the companies because the renewable energy industry is dominated by small- and medium-sized companies (Hinrichs-Rahlwes, 2013). Interestingly, influences of macroeconomic conditions cannot be observed in the group of renewable energy companies. Here, industry-specific aspects such as competitive intensity apparently dominate the industry development and lead to a general overestimation of companies' development (Phoenix Solar, 2011; SolarWorld, 2011).

As big German energy providers often overestimate the importance of renewable energies, renewable energy companies show a better forecasting performance than big energy providers in this case. Taking a closer look at renewable capacities, we see that the average annual growth rate of renewable energy capacities in Germany amounts to 10.4 per cent over the past 20 years and 14.5 per cent over the past five years (IEA, 2012). Thus, even RWE's annual growth rate of 9.6 per cent is below the German average, underpinning the overestimation of the importance of renewables by big energy providers. The discrepancy between forecasted importance of renewables and capacity expansion in combination with the comparatively low growth rates of capacities for renewables provide further evidence that the big German energy providers are still at an early stage of the transition toward a renewable future of the German energy industry. The analyses also reveal that renewable energy companies with the best forecasting quality in terms of importance of renewables reach the highest average annual growth rates. These results indicate that forecasting accuracy and, at least in part,

underestimation contribute to a faster transition of the German energy industry in terms of renewable capacities. As a too optimistic assessment of the importance of renewables does not seem to be related to above-average capacity growth, realistic expectations and assumptions are an important factor in the process of industry transition.

With respect to oil price forecasting quality, we can see a clear distribution according to years instead of companies or company groups. The good forecasting accuracy in 2007 is not surprising given the steep price increase of the oil price since 2002. But the results in 2008 show that merely linear extrapolation does not necessarily lead to forecasting accuracy (EnBW, 2007; E. ON, 2007), as the oil price suffered from a sharp decline in the second half of the year (Figure 3). In summary, forecasting quality of oil prices seems to be on a high level, given the complexity of forecasting raw material prices.

In summary, our results reveal that big energy providers are well-placed to forecast economic developments on the industry and company levels. But when it comes to predicting the future importance of renewable energies, big energy providers perform rather poorly. They mostly state the increasing importance of renewable energies for the company, while at the same time, companies' capacities for renewables stay stable or even decrease. This could be due to the fact that big energy providers have sufficient capacities and competencies to cope with the assessment of economic and financial developments. What seem to give rise to certain difficulties in terms of forecasting are the high costs and the uncertain political frameworks which have an active influence on the diffusion of renewable energies (Marques and Fuinhas, 2012). It may be the case that big energy providers attach importance to renewable energies because of the politically and socially intended transition to a renewable energy system. But first, renewable energy technologies still entail a greater expense than fossil-based technologies and are thus economically less attractive at the moment (Schilling and Esmundo, 2009). Second, the uncertainty of political support for renewables – which has the task of offsetting the



Source: Thomson Reuters Datastream (2013a)

Figure 3.
Oil price development from 2007 to 2011

high costs of renewables – can prevent big energy providers from further investing in renewable capacities. Worth naming in this context are the German feed-in-tariffs, particularly for photovoltaic energy, which have been changed frequently over the past few years and thus have alienated many investors (Grau *et al.*, 2012). So it seems that big energy companies are – in terms of forecasting – less able to cope with policy-related than with economy-related external shocks. While they even integrate well the impact of the global economic and financial crisis in 2008 and 2009 in their economic forecasts, they seem to be less able to derive valid forecasts in terms of renewable energies from current economic and political conditions.

Renewable energy companies, in contrast, do not seem to be considerably affected in their renewables forecasting quality by changing political frameworks. This could be due to the fact that renewable energy companies are – contrary to big energy providers – not faced with the choice between renewable and less costly fossil energies. While big energy providers can fall back on existing fossil energy capacities and postpone investments in renewables capacities, renewable energy companies exclusively concentrate on the development of renewables capacities, regardless of the stability of political frameworks. Given the low forecasting accuracy of renewable energy companies in terms of economic development and particularly the low company profitability, it might reasonably be concluded that unstable political conditions do affect renewable energy companies, but rather on the economic level. To return to the abovementioned example of feed-in tariffs in Germany, the solar industry is particularly affected by changing feed-in tariffs for solar electricity. Coupled with the fact that Chinese solar module manufacturers offer more competitive prices, the German solar industry currently suffers from severe economic problems (Grau *et al.*, 2012). The stock price of SolarWorld, for example, dropped from a maximum of €250 in 2006 to €20 in 2009 and less than €1 in 2013 (Thomson Reuters Datastream, 2013b). In summary, renewable energy companies should try to better integrate possibly changing political frameworks in their forecasts of economic developments, while big energy providers should try to better integrate possibly changing political frameworks in their forecasts of the importance of renewable energies.

6. Conclusion and outlook

In the course of the present paper, we analyzed German energy companies' forecasting abilities in terms of economic development, renewable energies and oil prices from 2007 until 2011 on the basis of annual forecasting reports. Concerning economic development on the national level, a comparison of real GDP development with the individual companies' assessments shows an average hit ratio of 59.3 per cent. In terms of economic development on the industry level, group analysis of energy companies shows a heterogeneous picture. While big energy providers and municipal utilities offer an overall good forecasting accuracy, renewable energy companies tend to overestimate industry development. It is noticeable that the average forecasting hit ratio of 48.4 per cent on the industry level was considerably lower than the average hit ratio on the national level of 59.3 per cent. On the company level, however, a clear distinction of forecasting quality between energy company types arises. While big energy providers demonstrate good forecasting accuracy (except in 2008), renewable energy companies again tend to overestimate companies' development. Municipal utilities were

characterized by continuously good hit ratios and a tendency to underestimate economic development on the company level.

The analysis of connections between the stated importance of renewable energies in forecasting reports and the development of companies' renewables capacities provided the following results: While the three big German energy providers systematically overestimate the importance of renewable energies, renewable energy companies in general show a better forecasting performance. In a third step, we tested a connection between companies' oil price forecasts and actual oil price developments. The results reveal that the quality of oil price forecasts reaches an overall high level, but seems to depend on time instead of company type.

For a successful participation in the transition toward a mainly renewable-based energy system, big energy providers should extend and enhance their renewable forecasting quality. While they integrate well the impact of the global economic and financial crisis in 2008 and 2009 in their economic forecasts, they seem to be less able to derive valid forecasts of renewable energies from the currently unstable political frameworks. Thus, it seems that big energy companies are – in terms of forecasting – less able to cope with policy-related than with economy-related external shocks. In the expectation that political conditions regarding renewable energies in Germany will remain unstable in the years ahead, big energy providers need to find the means of responding to the challenge and integrate changing political guidelines and support into their forecasting system. On the other hand, the aforementioned results can be understood as an invitation to policy makers to provide a more reliable and stable political framework to stimulate investments of big energy providers in renewable energies. On the contrary, renewable energy companies in our sample do not seem to suffer from these difficulties and provide good foresting accuracy in terms of renewable energy development. But they should focus on company-level profitability and the respective forecasting competencies to be economically in the position to successfully participate in the transition.

Nonetheless, our analysis suffers from several limitations. First and foremost, the semantic analysis of forecasting reports is not as objective as, for example, an analysis of balance sheets. For this reason, information has been extracted with care and accuracy and has been converted via scoring into a three-point ordinal scale, which is an adequate procedure for quantifying qualitative data. Further limitations consist in the short sample period of five years and the focus on the German energy market. Therefore, we suggest the analysis of further national markets and a repetition of the study with an extended number of data points. On this basis, a comparison on the European and on the international level could provide further insights. Subsequent to our results and discussion concerning the influence of unstable political conditions on renewables forecasting quality of big energy providers, it would also be interesting to further study this phenomenon and elaborate strategies for big energy providers how to deal best with the challenge of changing political frameworks.

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Appendix

Table AI. Calculation of indicators

Dimension	Indicator	Average (%)	Standard deviation (%)	Lower limit (%)	Upper limit (%)
Overall economic development	German GDP growth	1.36	2.00	0.01	2.71
Energy industry development	Sales growth of German electricity companies	2.66	5.70	−1.19	6.51
Importance of renewable energies	Growth of renewables capacities in Germany	10.47	5.98	14.51	6.43
Oil price development	Growth of crude oil Brent prices	8.64	25.05	−8.63	25.91

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