



# Facing the climate and digital challenge: European energy industry from boom to crisis and transformation



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## ABSTRACT

This article contributes to the understanding of the current transformation of the energy industry in Europe and the interplay between greening policies and digital technological innovation.

It shows how, since the financial crisis, core players in the European energy industry ended up in a dualist limbo, between conventional and emerging business models. It documents how strategies and business models that delivered extraordinary financial performance in the first decade of the 21st century often failed dramatically after the 2008 financial crisis. Yet it finds that incumbents with 1) a greener energy mix, 2) smaller scale and, quite naturally, 3) better financial performance fared better than others

The study explores the emergence of new business models and finds that most of the emerging business models circle around the customer interface where digital solutions allow more flexible interplay between consumption and production of energy, and/or between several service alternatives to fulfill basic needs for customer home comfort.

The article also discusses important policy implications: For competition policy, it indicates a shift from challenges of scale and scope towards challenges of regulating networks and dominant platforms. Furthermore, it highlights new policy dilemmas concerning balancing and energy storage to accommodate intermittent supply from renewables.

## 1. Introduction

### 1.1. Objectives

This paper explores and analyses the dramatic transformation of the European energy industry as it faces the dual challenge of strong greening policies and digital technological transformation. A first part (Sections 3–5) focuses on how traditional strategies and business models that delivered extraordinary financial performance in much of the first decade of the 21st century, often failed dramatically in the period after the 2008 financial crisis. Core questions are: How did the dynamics in electricity supply in Europe between 2000 and 2016 affect the business strategy of incumbent electricity companies in Europe and why were some incumbents more successful than others? A second part (Sections 6 and 7) explores the emergence of new business models in the energy industry, and examines how they herald new approaches that combine green transition with digital innovation.

### 1.2. Background and context

The focus of the central energy incumbents at the turn of the millennium was generally on scale and scope, based on classical

arguments of cost advantage gained due to size, scale of operation and co-production (Besanko et al., 2013; Gaughan, 2002). Such arguments had traditionally played a central role in the energy industry, ever since de-regulation in the 1990s and early 2000s brought these sectors under competitive pressure.

The period following the 2008 financial crisis saw a dramatic shift in business conditions for the European energy industry. Motivated by the need to meet the climate challenge, extensive public funding brought considerable volumes of renewable energy on the market in the early 2000s. New application of information technology allowed installation of some of this capacity by consumers, leading to a trend of self-supply ‘prosumership’ in many EU countries (Schleicher-Tappeser, 2012; Bughin and Manyika, 2012; WEF, 2016).

Against this background, our analysis focuses on business models, both of incumbent energy industry and emergent new players. We here draw on a growing literature on business models (Osterwalder and Pigneur, 2010; Zott and Amit, 2013) that seeks to integrate core business functions, such as products and services, logistics key resources, activities, revenue streams, partnerships and customer relations into a holistic analysis at the firm level. This perspective provides a holistic framework for addressing central challenges to incumbent energy industry (in Part I), such as: How extensive changes

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crisis their share prices plummeted and did not regain value even as general industrial stock price indexes crawled back to pre-crisis levels. In this section we explore how they met the challenging dynamics of the European electricity supply in the first 1 ½ decades of the 21st century, and why it was so difficult for them to adapt and regain economic momentum. We have chosen to start out with the two German super-majors, E.ON and RWE, in order to explore their strategic trajectory in some detail. We will thereafter more superficially complement the picture by adding on other incumbents that followed the same pattern.

### 3.1. The golden age of success: consolidating scale and scope

Both E.ON (2016) and RWE (2000a) started out the 21st century on a merger and acquisition spree as part of an accelerating consolidation in the electric-utility industry following the deregulation in the late 1990s. The massive upscaling of both companies took place against the backdrop of impressive economic success. Following the burst of the dot-com bubble, markets picked up in 2003, and both companies saw an extensive upswing in share prices, featuring growth many times higher than in the industry at large (Fig. 2).

The strategic framing expressed in both E.ON's and RWE's investor communication was that of scale and scope economics. This was illustrated in E.ON's very creation out of the merger between the two German companies VEBA and VIAG, which was Germany's largest merger, ever. The company continued to widen its geographic reach through the acquisition of British Powergen and its US subsidiary Louisville Gas and Electric. In E.ON's (2001) Annual Report, the presidents of the management board thus stated in their letter to the shareholders:

“We aim to occupy a leading position of truly European dimensions. But we also intend to have market positions overseas.” (E.ON, 2001).

The scale and scope strategy was balanced by a complementary focus on industrial consolidation. In its striving for energy leadership, E.ON divested other assets and framed itself as a pure electricity and natural gas company.

RWE undertook the same strategy as E.ON in pursuing a scale and scope strategy. It also started the millennium with a huge merger by joining the Westphalian VEW to its portfolio. Like E.ON, RWE combined its scale and scope approach with consolidation and industrial focus. However, the company chose to establish itself as a multi-utility business with a somewhat wider framing of its industrial scope than E.ON's multi-energy configuration. As stated in the 2000/01 letter to shareholders:

“With our four core lines of business: electricity, gas, water, plus waste management and recycling, our aim is to be one of the leading multi-utility enterprises of an increasingly united Europe ...” (RWE, 2000b)

In line with E.ON, RWE expanded overseas, aspiring to become a global player by acquisition of British Thames Water and later American Water Works. It also made further large acquisitions in European markets, including most of Czech gas industry as well as Innogy, one of the three largest energy utilities in the UK (RWE, 2002).

Parallel to this expansion, RWE consolidated its business model by selling off non-core assets.

Towards the end of the ‘golden age’, RWE crowned its scale and scope strategy by engaging in massive investments in new generation capacity, even including an ambition to reinvent itself as a major nuclear player abroad as stated in the letter to its shareholders:

“We have initiated the biggest investment program in RWE's history”. (RWE, 2007).

#### 3.1.1. The green dimension

Neither E.ON nor RWE started the new millennium by reframing themselves as green pioneers. With a critical attitude to German green energy policy, they saw themselves as conventional actors aimed at moving slowly towards a green agenda with conventional low-carbon solutions like natural gas playing a major role (E.ON, 2002, 2001; RWE, 2006, 2000b). Gradually both companies, however, revised their harsh critique of government greening policies and took part of the green agenda on board, but predominantly in line with conventional energy supply (E.ON, 2005; RWE, 2006).

In spite of these moves towards a greener re-framing, both E.ON and RWE remained solidly anchored in conventional generation. From 2000–2007, the coal share of E.ON's power generation had only decreased by about one percent. The major change was a shift from nuclear towards gas, with a more minor change toward renewables. RWE's development was rather similar (Table 1).

#### 3.1.2. Summing up the golden age

By 2007, both E.ON and RWE could note great successes. The two companies had built up their broad and integrated energy supply chains through ambitious mergers and acquisitions. They had also consolidated their business focus through sales of non-core business, thereby generating financial assets that allowed further expansion.

Both companies maintained a broad engagement along the whole energy value chain including competencies from generation, transmission, wholesale trading, distribution and retailing.

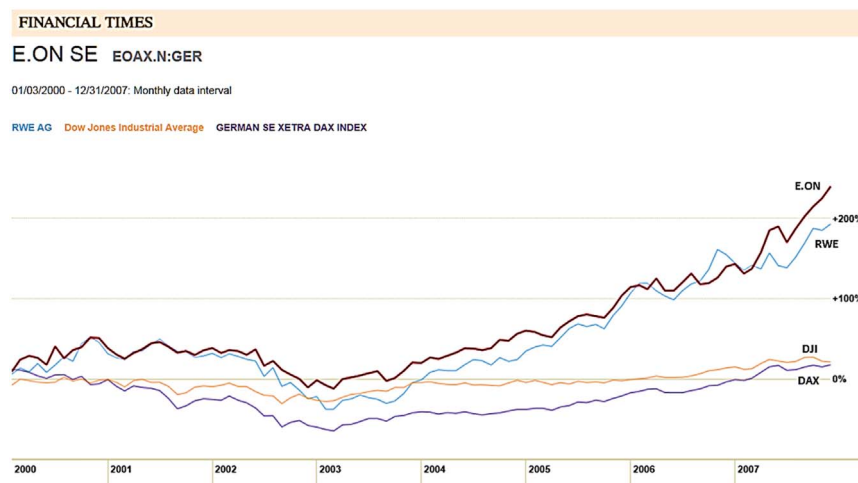


Fig. 2. E.ON and RWE Benchmarked against DAX and DJI 2000–2007. (Source: Financial Times (2016))

**Table 1**

Source-Mix from Power Generation in the Golden Age – E.ON and RWE.

Source: E.ON (2008c, 2000), and RWE (2007, 2000b).

Source Mix		Coal and Lignite (percentage)	Gas and Oil (percentage)	Nuclear (percentage)	Renewables (percentage)	Total Capacity (TWh)
2000	<b>RWE</b>	61,5	2,5	30,2	5,9	138,3
	<b>E.ON</b>	44,3	3,8	44,5	7,4	124,5
2007	<b>RWE</b>	68,1	14,7	14,9	2,4	216,1
	<b>E.ON</b>	43,0	16,0	30,0	11,0	257,1

Their product or value proposition was to develop integrated energy services, including electricity and gas, with a high security of supply at competitive prices. RWE initially sought to offer broader multi-utility services beyond energy, including both waste and water management. However, the company gradually pulled back to the position of an integrated energy services company (Fig. 3).

Financially, the ‘golden age of success’ was highly profitable for both companies. Electricity prices were rising, and energy industry shares grew at a much higher rate than the rest of the economy. The business model was strengthened by value feedback from the stock market, boosting E.ON and RWE stocks far beyond the industrial average. This development and a similar boom in profit rates made it hard to question business as usual.

### 3.2. Crisis and transformation

The financial crisis and the following slowdown of the European economy offered a serious blow to the profitability of the two German incumbents. As opposed to the German economy as a whole, the share value of E.ON and RWE did not pick up, but rather continued on a downward trend (Fig. 4).

In this period, both E.ON and RWE undertook a major reframing of their strategic outlook. The first step was to emphasize efficiency and consolidation as core foci in meeting what was seen to be a temporary economic downturn.

“Measures to improve efficiency are a priority” (RWE, 2015),... and “We will optimize operating processes throughout the Group and reduce administrative costs.” (RWE, 2012)  
 “By initiating a group wide efficiency-enhancement program that we call “Perform-to-Win” we act early and from a position of strength.” (E.ON, 2008a)

A second step in reframing was to gradually introduce green energy as a more substantive area of focus, thus aligning more with public energy policy.

“Renewables will remain a big part of our future, and we’ve continued to expand this business.” (E.ON, 2012)

Over the years following the financial crisis, both E.ON and RWE thus moved towards more dualistic business models. They fought hard

to retain the traditional centralized carbon-based model, and in RWE’s case, the company invested heavily in it. As indicated in the left part of Fig. 5, the companies sought control over the whole value chain in electricity and the downstream part of gas. For a period RWE sought to also integrate water, sewage and waste in a broad multi-utility model (dotted circle) but the company soon retreated to an energy utility approach. The new emergent models – Fig. 5, right side – in part expand toward new renewable upstream engagement. In part, however, they concentrate on the customer interface – towards the centre of the figure.

Their generation portfolios, however, remained heavily carbon-based. Table 2 illustrates this and indicates the inertia built into large-scale centralized energy systems.

In the long run, however, the companies’ ambivalence about their carbon/nuclear and renewable strands finally led to organizational splits. In a dramatic move, E.ON in its 2014 annual report accepted that the challenge to its business was of deeper and structural nature, and hence has to be met with more fundamental strategic rethinking.

“The new energy world is about customer orientation, efficient and increasingly smart grids, renewables, distributed generation, and technical innovation. The conventional energy world, by contrast, requires expertise and cost efficiency in conventional power stations and global energy trading. We’re determined to do our best in both energy worlds by creating two companies that will focus on meeting their respective challenges.” (E.ON, 2014)

A strategic repositioning of E.ON took place in 2015, when conventional power generation from hydro, natural gas and coal and global energy trading were assembled in the new company Uniper. This company thus continues to focus on the challenges and opportunities of the classical energy industry in conventional production and international energy trading. The remaining parts of E.ON, under its own brand name, focused on the new energy market with renewable energies, energy sources and customer solutions (Brunnengräber and Mez, 2016).

RWE also split up its ‘old’ and ‘new’ portfolios under different names, but – as opposed to E.ON, chose to retain the RWE brand for its old portfolio. The new portfolio was built on its green energy subsidiary, RWE Innogy which was transformed to a new and much stronger unit “Innogy”, by adding on the network and retailing business.

In both cases the ‘new portfolio’ unit became far larger than their old portfolio companies, as measured by stock market value (Fig. 6).

Both E.ON and RWE had to continue to carry the responsibility for decommissioning their nuclear assets (Brunnengräber and Lutz, 2016).

## 4. Incumbents following the E.ON & RWE pattern

E.ON and RWE’s pattern of value-loss was paralleled by many other incumbent energy utilities. The Italian-based Enel, the French ENGIE, the French nuclear champion EDF and the Austrian hydropower-based VERBUND had seen a massive rise in share value under the ‘golden age’. However by 2016, all the gains had evaporated and they found themselves with net-value losses compared to 2000, (for EDF and ENGIE compared to 2005, when their shares were noted on the stock

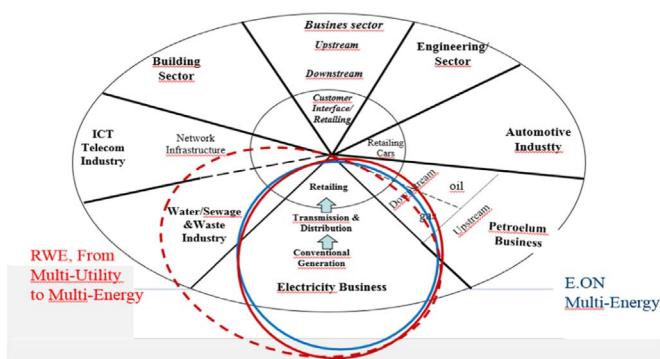


Fig. 3. Consolidating Multi-Energy and Multi-Utility Business Models.



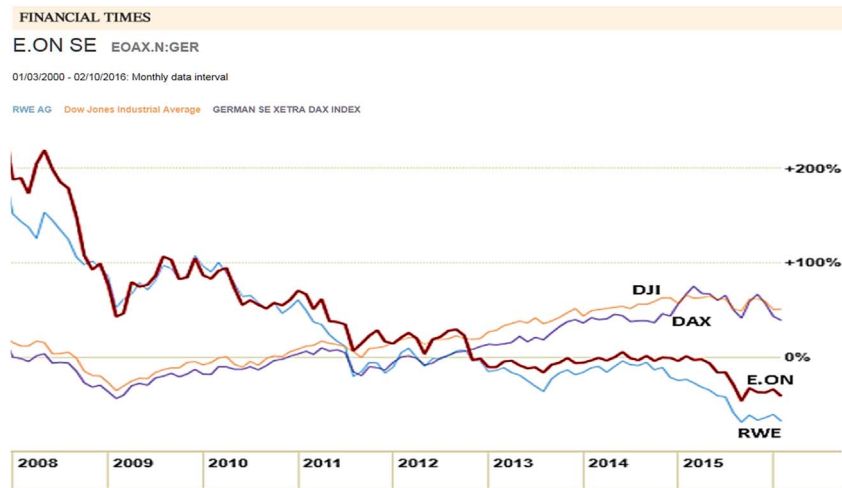


Fig. 4. E.ON, RWE Benchmarked against DAX and DJI 2008–2016. Base year 2000 = 0%. (Source: Financial Times (2016))

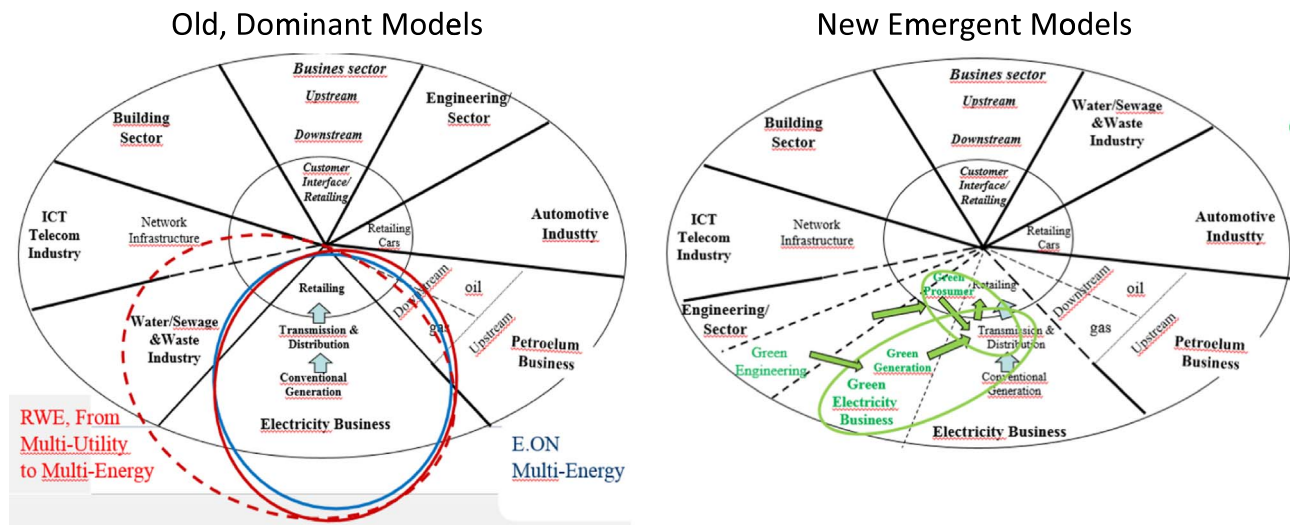


Fig. 5. E.ON and RWE' dual Structures.

exchange) (Fig. 7).

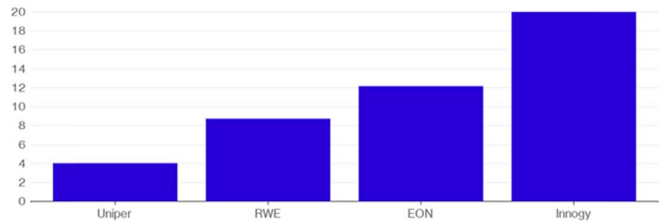
4.1. Scale and scope

Like E.ON and RWE, many other energy incumbents were heavily focused on scale and scope in the early 2000s. ENGIE was thus founded by a French-Belgian mega-merger of Gaz de France and SUEZ, and focused strongly on gaining new positions international growth markets.

Likewise, EDF also started the 2000s in an expansive mode, including acquisitions of British Energy as well as Constellation Energy Nuclear Group in the USA to participate in the nuclear revival in respective countries. The Fukushima catastrophe, however, changed the tone towards a more defensive focus on nuclear safety, and with

Innogy Becomes Germany's Most-Valued Utility

Market value in billion euros\*



Bloomberg, Innogy  
\*Based on closing price on Oct. 6, 2016, for Uniper, RWE, E.ON; on IPO issue price for Innogy

Fig. 6. Market Value of New and Old E.ON and RWE Units. (Source: Andresen and Hyde (2016))

Table 2  
Source Mix of Power Generation under Crisis and Transformation – E.ON and RWE.  
Source: EON (2015, 2008b) and RWE (2015, 2008).

Source Mix		Coal and Lignite (percentage)	Gas and Oil (percentage)	Nuclear (percentage)	Renewables (Percentage)	Total Capacity (TWh)
2008	RWE	60,6	15,0	22,0	2,4	224,1
	E.ON	39,0	27,0	24,0	10,0	317,6
2015	RWE	58,4	21,4	14,9	5,4	213,0
	E.ON	26,0	33,7	26,4	13,8	188,5

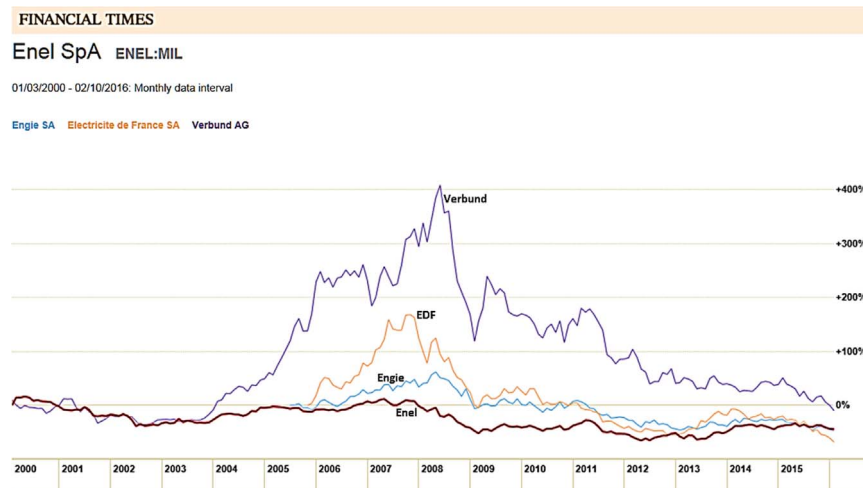


Fig. 7. Major European Energy Companies with Share Value Losses 2000–2016. (Source: Financial Times (2016)).

EDF focusing on its ability to deliver nuclear power without serious risk. EdF also developed a green subsidiary - Energies Nouvelles. This unit was listed on Euronext Paris in 2006 but was reintegrated with the mother company in 2011.

ENEL also scaled up, including engagement in growth markets outside of Western Europe with renewables engagements in Latin-America, Russia and Eastern Europe.

VERBUND, on its side, continued expanding from its hydropower base, supplementing it by low-carbon thermal power and wind power". The company worked to consolidate presence in Austria and Germany, and remained broadly invested in the whole conventional value chain in its home country.

#### 4.2. Lean and transition

However, like E.ON and RWE the four other energy incumbents ended up retreating from scale and scope towards lean production and gradually strategic shifts in business models.

ENGIE/GdF-SUEZ made a radical shift in 2013, when the company claimed that: "Our Group was the first energy company to embark on radical measures by announcing our strategic shift along with some major asset write-downs.

Verbund gradually engaged more strategically in exploring new customer-interfaces. In its 2012 annual report, the company thus flagged an engagement in E-Mobility together with Siemens, and in its 2014 report it also announced the offering of new services combining renewable energy with innovative solutions.

In addition to their nuclear strategy, EDF already in 2009 flagged engagement with customer eco-efficiency as a strategic orientation. In the words of their CEO and Chairman of the board: "We must also lead the way when it comes to energy efficiency, supporting our customers' energy eco-efficiency initiatives and developing still more innovative solutions for demand-side management.

Following the Fukushima catastrophe, ENELs (2011) report flagged Italy's and Enel's exit from the nuclear development program. Instead, the company announced that it would increase its focus on distribution and the customer interface.

#### 4.3. Greening

For most companies, the post-crisis transition also involved greening.

For Verbund, with its tradition of hydro-based generation, greening came as a continuation of previous practice, though with a stronger flagging. As indicated in its 2010 letter to the shareholders:

"Clean, sustainable hydropower has always been the backbone of our Group. And it will play an even more important role in the Europe of tomorrow.

When it comes to ENEL, the company faced the challenging post-financial crisis economy with the formation of a renewable energy division as well as the spinout of a new green company 'Enel Green Power'.

ENGIE also followed other incumbents by flagging green transition. In its 2014 activities report:

ENGIE's "aim is to become the energy architect for tomorrow's world by focusing its energies on renewables, energy efficiency, the natural gas supply system and the new business lines made possible by digital technology."

EDF, claiming to already be the European leader in renewable energy, in its 2015 report set itself the goal of doubling its net installed capacity and created a Renewable Energy Division with representation on the Executive Committee (EdF, 2016).

#### 4.4. Strategizing under transition

While the first 'golden age' of scale and scope competition of a mature industry invited strategic orientation geared at further improvement in the same direction, the second 'age of transition' has invited a more process-oriented strategic perspective to deal with an emerging new industrial field. But the shift between these two strategic perspectives has been painful and challenging. Firstly, the complex interplay of factors that undermined traditional business models was too confusing to register at an early stage. Secondly, the positive feedback from capital and energy markets was such that they reinforced ties to the old model. When share prices were skyrocketing and profit margins were soaring, there was little incentive to seriously question existing business models. Only after the positive feedback loop had been undermined, incentives for transformation emerged.

However, as the commercial and political environment did indeed change substantively, this was at first interpreted as a temporary disruption of business as usual, to which the market would soon return. Adjustments in the business models were thus tactical as the traditional business model remained unquestioned. Only after the persistent failure of the traditional business model did a radically new business strategy evolve.

### 5. Successful incumbents

While the dominant pattern among the European incumbent energy-majors was failing value creation, there were also energy

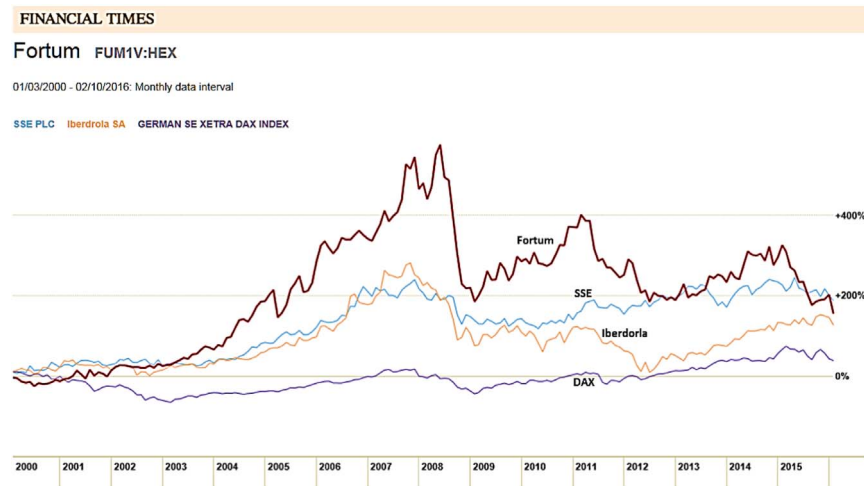


Fig. 8. European Incumbents with Share Value Gains 2000 – 2016. (Source: Financial Times (2016)).

incumbents that performed clearly above the industrial average (Fig. 8). The Finnish energy incumbent Fortum and the British incumbent SSE (Scottish & Southern Energy) both, in the beginning of 2016, saw their share prices up more than 200% compared to 2000. This was more than twice the share price increase in the general economy. Iberdrola is another energy-major that had a positive-share price development, particularly after 2012.

So, can we explain why some incumbents were more successful than others? At a first glance this seems difficult. Even the group successful companies exhibits considerable variation: For instance, while Iberdrola, Enel and Engie have attributed much of their revenue from extensive engagement in external growth markets, SSE has boosted its share price through strong engagement in the home market. In addition, SSE, has highlighted its broad engagement across generation, transmission and distribution, and telecoms as success factors; while Fortum has highlighted its concentration of production and sales, and its divestment from distribution as a reason for success.

Nevertheless, in the statistical analysis, three indicators stand out as factors behind share value success: 1) the energy mix, 2) the business scale and 3) financial performance of European energy players in our case study.

### 5.1. The energy source effect

As indicated in Table 3, in terms of share prices, companies that have scaled up renewables, especially wind power, have done significantly better in the period after the financial crisis (2008–2016). The fact that the renewables and wind effect comes only in the second period may be indicative of the change in energy policy outlook, and guaranteed feed-in tariffs for renewables, in contrast to brutal markets for conventional generation.

### 5.2. The size effect

Our other significant finding is a negative size effect on share price development. As indicated in Table 4, this effect only appears in the first period (2000 – 2007), when scale and scope were strategic foci. The negative effect on share price may perhaps indicate that the dramatic merger and acquisition spree of the largest companies may have negatively affected their liquidity. In the second period, this effect may have drowned under general financial duress.

### 5.3. The financial performance effect

Thirdly, there is also – as one would expect – an effect of financial performance on share price development, particularly in the second

Table 3

Correlations between Energy Source Mix and Change in Share Price (2000–2016).

		Share price '00 – '07 (%)	Share price '08 – '16 (%)
% Wind power 2015 (TWh)	Pearson	–,068	,770*
	Correlation		
	Sig. (2-tailed)	,874	,025
	N	8	8
RE_Output change 2000 – 2015 (% change in TWh)	Pearson	,067	,821*
	Correlation		
	Sig. (2-tailed)	,874	,012
	N	8	8
RE_Proportional change 2008 – 2015 (% change in TWh)	Pearson	,055	,763*
	Correlation		
	Sig. (2-tailed)	,888	,017
	N	9	9
RE_Proportional change 2000 – 2015 (% change in TWh)	Pearson	–,284	,781*
	Correlation		
	Sig. (2-tailed)	,495	,022
	N	8	8
Wind_Proportional change 2008 – 2015 (% change in TWh)	Pearson	–,056	,804*
	Correlation		
	Sig. (2-tailed)	,895	,016
	N	8	8
Wind_Proportional change 2000 – 2015 (% change in TWh)	Pearson	–,181	,802*
	Correlation		
	Sig. (2-tailed)	,698	,030
	N	7	7

\*Correlation is significant at the 0.05 level (2-tailed).

\*\*Correlation is significant at the 0.01 level.

Bloomberg (2016), EDF (2015, 2008a, 2008b, 2008c, 2007a, 2007b, 2003), Enel (2015, 2009, 2008a, 2008b, 2000b), ENGIE (2015, 2008), EON (2015, 2008b, 2008c, 2006, 2000), Financial Times (2016), Fortum (2016, 2015b, 2008, 2007, 2001), Iberdrola (2016, 2015, 2009, 2000), RWE, (2015, 2008, 2007, 2000b), SHE & SE (2001), SSE (2015, 2009), Verbund (2015, 2008, 2007, 2000).

period, when the challenges to the energy industry created clearer distinctions between winners and losers. As shown in Table 5, indicators of sound economic management, such as Return on Equity (ROE), have had a substantially positive share price effect. Liquidity indicators such as interest coverage ratio<sup>1</sup> also correlated significantly with share price in the second period. Dividend payment also affected the share price positively.

<sup>1</sup> The Interest Coverage Ratio is measured by cash flow from operations before changes in working capital (CFO pre W/C) as practiced in Moody's rating methodology for unregulated utilities and unregulated power companies

**Table 4**  
Correlations between Installed Capacity and Share Price (2000 – 2016).

		Share price '00 – '07 (%)	Share price '08 – '16 (%)
<b>2008 Installed capacity (MW)</b>	Pearson	–,678 <sup>*</sup>	–,400
	Correlation		
	Sig. (2-tailed)	,045	,286
<b>2015 Installed capacity (MW)</b>	N	9	9
	Pearson	–,714 <sup>*</sup>	–,295
	Correlation		
	Sig. (2-tailed)	,031	,440
	N	9	9

\*\*Correlation is significant at the 0.01 level (2-tailed).

Computation based on information from: EDF (2015, 2008b, 2007b, 2003), Enel (2015, 2009, 2008b, 2000b), ENGIE (2015, 2008), EON (2015, 2008b, 2008c, 2006, 2000), Financial Times (2016), Fortum (2016, 2008, 2007, 2001), Iberdrola (2015, 2009, 2000), RWE (2015, 2008, 2007), SHE & SE (2001), SSE (2015, 2009), Verbund (2015, 2008, 2007, 2000).

\* Correlation is significant at the 0.05 level (2-tailed).

**Table 5**  
Correlations between Financial indicators and Share Price (2000 – 2016).

		Share price '00 – '07 (%)	Share price '08 – '16 (%)
<b>Dividend change '08-'15 (%)</b>	Pearson	,438	,694 <sup>*</sup>
	Correlation		
	Sig. (2-tailed)	,239	,038
	N	9	9
<b>ROE 2015</b>	Pearson	,055	,809 <sup>**</sup>
	Correlation		
	Sig. (2-tailed)	,889	,008
	N	9	9
<b>CFO pre W/C Interest Coverage 2015</b>	Pearson	,189	,698 <sup>*</sup>
	Correlation		
	Sig. (2-tailed)	,626	,037
	N	9	9

Computation based on information from: Bisset et al. (2014), Bloomberg (2016), EDF (2015, 2009, 2008b, 2000), Enel (2015, 2008a, 2000a), ENGIE (2015, 2009, 2008), EON (2015, 2008b, 2007, 2000), Financial Times (2016), Fortum (2015a, 2008, 2001), Iberdrola (2016, 2008, 2000), Investopedia (2016), RWE (2015, 2008, 2007, 2000b), SSE, (2015, 2008, 2001), Verbund (2015, 2008, 2000)

\*\* Correlation is significant at the 0.01 level (2-tailed).

\* Correlation is significant at the 0.05 level (2-tailed).

## 6. Renewables, a safe haven?

Given the extensive focus on climate change and the need for green transition, renewables would appear to be a secure bet, and companies with a pure green profile should likely become market winners. A study of 1) green spinoffs and 2) green energy-technology providers – both with separate stock price quotations- indicates that these expectations are justified, although not without exceptions.

### 6.1. Green spinoffs from incumbents

The two green spinoff cases in our study include Enel Green Power (EGP) and EDP Renovaveis (EDPR). EGP - the spinoff from Enel Group - engaged in a broad spectrum of renewable technologies, namely hydro, wind, geo-thermal, solar and biomass, while the green Portuguese spinoff – EDPR – focused mainly on wind energy, with a small stake in solar power (Table 6).

EDPR Renovaveis (EDPR) cleverly built up a sustainability profile, by positioning itself on the FTSE4Good<sup>2</sup> and Dow Jones Sustainability

<sup>2</sup> The FTSE4Good Index is a series of ethical investment stock market indices launched in 2001 by the FTSE Group.

**Table 6**  
Source-Mix for European Green Spinoffs.  
Source: EDPR (2016a) and Enel (2016).

Source Mix	Hydro (%)	Wind (%)	Geo-thermal (%)	Solar and Biomass (%)	Total Capacity (TWh)
<b>2015 Enel Green Power (EGP)</b>	31,0	47,9	18,5	2,6	33,6
<b>EDP Renovaveis (EDPR)</b>	0,0	100,0	0,0	0,0	21,4

indexes. (EDPR, 2011) and focused its strategy on a future where renewable energy was about to become the new mainstream.

By focusing on engagement in selected geographical areas and in renewables with attractive support programs, Enel Green Power achieved a strong and profitable growth with prospects for further development globally. As indicated in Fig. 9 and Table 7, when benchmarked against the typical incumbents' profile, both have been fairly successful and more lucrative than their mother companies.

### 6.2. Green equipment suppliers

The green renewable technology suppliers in our study includes two wind turbine producers Vestas and Nordex, and solar panel producer SolarWorld, all selected because they were important players and have stock price quotation.

Vestas (2016) emerged out of the very expansive Danish wind energy market since the 1980s. The company positioned itself as the market-leading wind turbine manufacturer with an ambition to “deliver best in-class wind energy solutions”. The company saw a fabulous growth in share prices in the 2005–2008 period, ending up with almost 750% value growth (Financial Time, 2016). However, like many other companies, Vestas' share price was hit by the financial crisis in late 2008 and lost much of its share value in the 2010–2012 period (Fig. 9). However, In 2013, the company regained its offensive momentum (Vestas, 2008, 2013).

Nordex (2016), a much smaller, mid-size producer of onshore wind power systems experienced much of the same development as Vestas, only with more dramatic booms and busts (Fig. 9).

The third green technology provider, SolarWorld grew from a dealer to an international group, which successfully made use of rising demand to achieve extensive growth in the lucrative German market and beyond. At its peak in 2007, the company enjoyed around 670% growth over the preceding three years (Financial Times, 2016). After major hurdles while adapting to the new market conditions after the financial crisis, the company's strategic outlook took on a more positive tone. Yet the share price did not pick up, perhaps reflecting the strong competitive challenge in solar cell production (Fig. 10).

### 6.3. Summing up green players

To sum up With respect to economic performance, as judged by the share price development, there is little doubt that specialization in green power has created added value. The relative advantage of green is also indicated through earnings before Interest and tax (EBIT). With one exception, the green players had significantly higher EBIT change during the period 2008–2015. The exception is Solar World, which reflects the challenging competition from Asiatic production (Fig. 11).

A number of other companies could have been added to the list of green players, this includes companies like Enercon and Senvion, both major German wind energy players. It also includes Siemens the German engineering company, which has engaged heavily in wind through its renewable energy division. However, as they are not listed on the stock exchange throughout the period of our study, they could



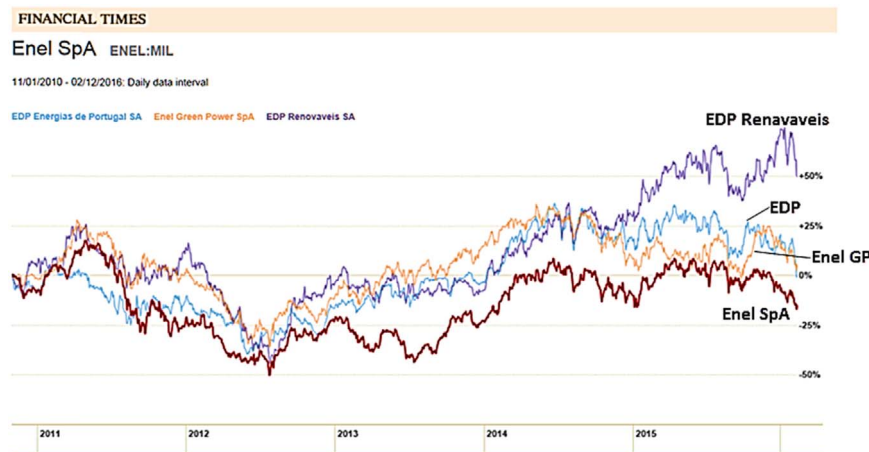


Fig. 9. EDP Renovaveis and Enel Green Power Benchmarked Against their Mother Companies. (Source: Financial Time (2016)).

Table 7

EDP Renovaveis and Enel Green Power Benchmarked Against their Mother Companies. Source: EDP (2015), EDPR (2016b), Enel (2015) and Financial Times (2016).

Share Price (€)	2010 (Nov. 01, 2010)	2016 (Feb. 10, 2016)	Change 2010– 2016 (%)	Renewables in Energy Mix 2015 (%)
Enel Green Power*	1,60	1,70	6,2	100,0
Enel	4,08	3,53	–13,5	31,4
EDP	4,15	6,60	59,0	100,0
Renovaveis				
EDP	2,75	2,88	4,7	58,0

\* First trading record Nov. 01, 2010.

not be included. Siemens general listing would be too broad.

## 7. Emerging business models from new actors

Numerous studies have pointed out that European electricity industry is not only facing a challenge from green power, but also from new digitally based business models. The Economist, thus, in January 2015 argued that power industry must move from supply to demand management (Economist, 2015). Mc Kinsey engaged with a study of “The digital Utility New Opportunities and Challenges (Booth et al., 2016). Likewise, Capgemini sponsored a study on “Designing the New Utility Business Model (Bigliani et al., 2015). MIT has followed suit with a report on “Business Models for Distributed Energy (Burger and Luke, 2016). Finally, the OECD emphasized challenges and possibilities for the energy sector, in its 2016 digital outlook. Building on these sources, supplemented with internet based desk research, we have found that most of the new emerging digital business models can be divided into three broad categories: 1) distributed energy, 2) broad customer-centric models, and 3) smart grids. These categories are not mutually exclusive and have considerable interfaces but represent biases within a common exploitation of new digital opportunities.

### 7.1. Distributed energy

The distributed energy model locates electricity production with customers, typically based on installation of solar panels in flexible interplay with centralized energy supply. Sungevity (2016) is an interesting and innovative example.

The company was founded in 2007, in Oakland, California and has rapidly expanded both in the USA and more recently in Europe as a challenging player in the market. Sungevity offers users residential

solar energy solutions online and receive a quote without any site visits. This is achieved by utilizing satellite-imaging technology to assess residential rooftops for solar panels, combined with Sungevity's software for analysis of the production yield. The digital and automated process makes the business model highly cost-efficient and scalable. The local installation is executed by licensed solar panel installation experts. The offer is made attractive and affordable to a broad set of customer groups through a number of payment options, including various leasing models as a purchase option, to some extent differing by location and credit history.

With the ‘prosumer’ concept, Sungevity and other similar companies have challenged the conventional business model of electricity industry at the customer interface, as indicated in the large red circle in Fig. 12. The model draws on competencies and resources from ‘green engineering’, ICT - particularly satellite imaging and construction industry (respective small red circles in Fig. 12).

### 7.2. Broad customer-centric models

The broad customer-centric model attempts to integrate energy into a wider *smart home* platform, across different manufacturers, brands and devices. According to sector analysts, the global smart home market is growing exponentially, attracting an array of service providers, including technology giants and startups to major media players, device makers, big-box retailers, home improvement companies, utilities and telecom network operators (Markets and Markets, 2016).

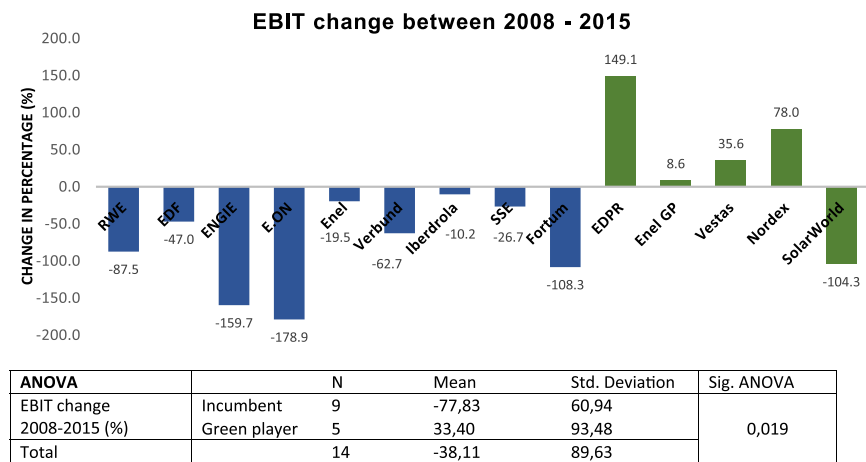
Qivicon (2016) is an interesting and innovative example. It is an alliance of leading industrial enterprises in Germany, initiated by Deutsche Telekom to drive a connected home system that appeals to residents. Qivicon and its partners have therefore been developing an ecosystem that covers not only energy efficiency at home but also the areas of security, convenience and health. To achieve this, Qivicon has chosen a vendor-neutral solution that enables users to combine different brands of Smart Home solutions (Hauptfleisch, 2014; Rodrigues, 2014).

Like the prosumer model, the smart house model challenges the incumbent central electricity industry at the customer interface. However, unlike the prosumer model, the smart house model does not involve instalment of new generation capacity, but rather establishes a multifunctional platform to allow customers to manage several ‘home functions’ (red oval in Fig. 13).

Other actors, like the German energy service provider, Techem (2016) is moving into the ‘smart home’ space from an estate management position. As indicated in Fig. 14, Techem's home management system is linked up to a radio technology for remote reading, which forms the basis for Techem's added-value services for all aspects of energy, water and cost savings. This offers customer advantages such as prompt billing, perma-



Fig. 10. Share price development of green equipment suppliers 2005 – 2016. (Source: Financial Times (2016)).



Computation based on information from: Bloomberg (2016), EDF (2015, 2009), EDPR (2015, 2008), EGP (2015, 2008), Enel (2015, 2008a), ENGIE (2015, 2008), E.ON (2015, 2008b), Fortum (2015a, 2008), Iberdrola (2016, 2008), Nordex (2015, 2008), RWE (2015, 2008), SolarWorld (2015, 2008), SSE (2015, 2008), Verbund (2015, 2008), Vestas (2015, 2008)

Fig. 11. EBIT change between 2008–2015 in percentage.

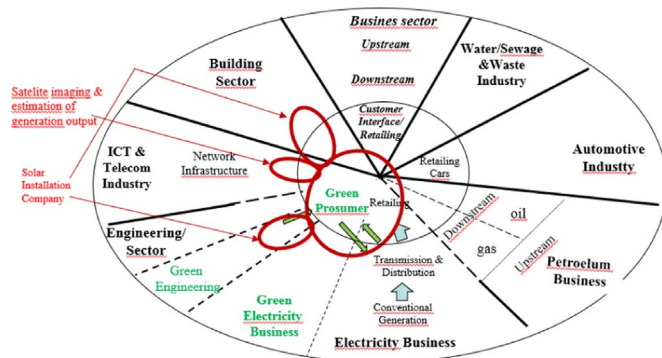


Fig. 12. Green Prosumership & Systemic Integration (ex Sungevity).

nent supervision with automated device monitoring, and retrieving of reading values, allowing for transparent consumption and cost overviews. It also allows automatic control of heating systems with a saving potential, which, the company claims, could be up to 10% a year (Techem, 2016). As indicated in Fig. 14, estate management (large red oval) is thus combined with novel engineering services (small red oval) with implications for energy consumption.

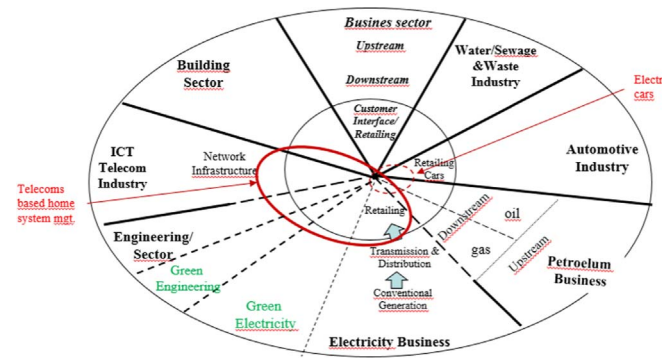


Fig. 13. ICT/Telecoms-based System Integration (ex: Qivicon).

Techem resembles Qivicon with respect to building an interface between traditional integrated supply infrastructures and the customer. However, Techem's interface within the building sector is wider, and includes water, gas, electricity as well as central heating. Techem's business model is also designed to be well aligned with policy initiatives in its European home markets, including the Energy Efficiency Directive (EED), which obliges all EU member countries to increase efficiency, e.g. by introducing consumption-based billing.

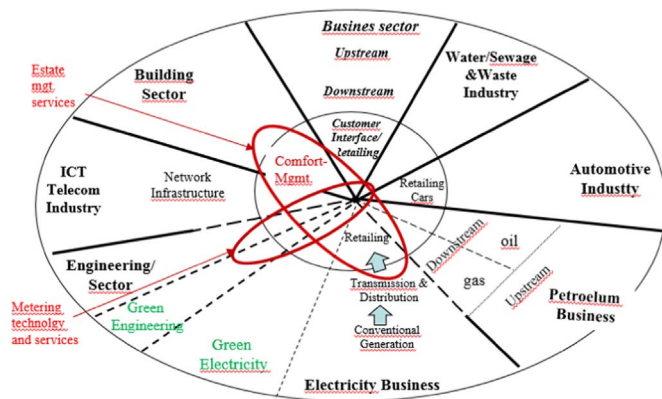


Fig. 14. Systemic Integration through Extended Estate Management (ex Techem).

### 7.3. Smart grids

The smart grid resembles the smart home in its ambition to link up several functions to a common platform that allows for holistic management. However, while the smart home targets the individual household, the smart Grid concept penetrates deeper into the supply chain and includes producers, distributors and consumers (large red circle in Fig. 15). The recent German startup *Kiwigrd* (2016) is an interesting example. The company has developed a system that offers a flexible and adaptable platform solution to equipment manufacturers and energy utilities. It allows them to manage, monitor and control distributed energy resources like generators, storage, energy consumers and e-mobility, as well as to manage their interface with the electricity grid and centralized electricity supply, as indicated in several smaller red circles in Fig. 15.

Kiwigrd's business model thrives on the complexity of the modern energy system in Europe. The extensive inputs from decentralized generation make the type of coordinated management that Kiwigrd facilitates increasingly necessary. However, the network economics of the smart grid model implies that the success of Kiwigrd's business model depends on the actors that buy into its platform. In addition to functionality, stability and security, the company must therefore succeed in engaging participation from a critical mass of core actors. The business model is otherwise similar to the 'smart home' model and includes payment from business partners that use the platform for vending products. In addition come user fees and purchase of devices connected to the platform (Fig. 15).

### 7.4. Emerging business models – what do they bring to the table?

Most of the emerging business models circle around the customer interface where various digital solutions allow more flexible interplay

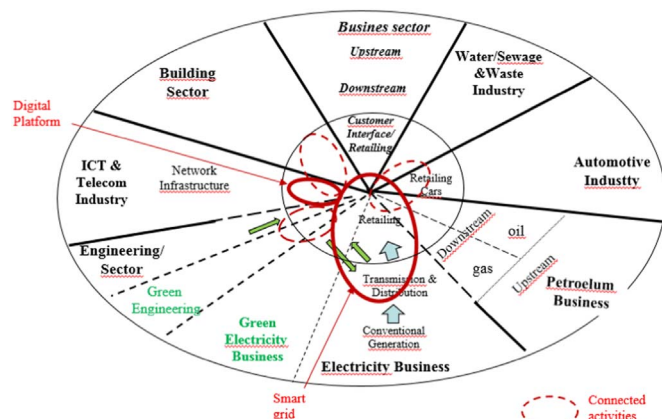


Fig. 15. Smart Grid -based Systemic Integration (ex Kiwigrd).

between consumption and production of energy, and/or between several service alternatives to fulfill basic needs for customer home comfort. Seen from an energy-sector perspective, they represent introduction of new platforms for service bundling, where energy is one of the core elements. These platforms are often controlled by new entrants from other sectors, and energy incumbents are potentially reduced to one of many service providers that the platform can combine in various ways tailored to customer needs.

The prosumer model introduces decentralized energy production at the consumption site in competition with established centralized systems. It capitalizes on flexible grid-access, often with net-metering mandated by new regulations. This allows the prosumer model to balance out intermittent production against flexible complementary supply from the central system without costs beyond the regular charge for net consumption. When this model is complemented with an efficient online exploration of residential solar energy solutions and a simple and understandable contractual model, it becomes a highly attractive alternative.

The new digitally-based model, which is aligned with traditional the energy industry, is the smart grid model. This model allows the conventional electricity grid to expand its scope by adding on a flexible and adaptable platform solution for energy utilities, to manage, monitor and control new distributed energy resources like generators, storage, energy consumers and e-mobility.

The building comfort and home system management represent digital platforms that transfer extensive control over the energy services to other actors with platform control. While the internet and telecommunication companies are moving into the 'smart home' space from internet and mobile telecommunication platforms, other actors are building up 'smart home' solutions from such positions as the holistic management of a client's technical systems. Either way, the electricity supply will be integrated in and subsumed under more general management systems, where it will be more systematically exposed to competition from alternative solutions and loose the direct customer- interface (Fig. 16).

## 8. Conclusions and policy implications

### 8.1. Conclusions

To sum up, this article has shown how, in just a scant decade since the financial crisis, core players in the European energy industry have ended up in a dualist limbo, between conventional and emerging business models. From strategies of scale, scope and oligopolistic power based on conventional technologies preceding the financial crisis, the energy industry is moving into new uncharted terrain characterized by greening, digitalization, decentralization and disruptive innovation (Fig. 17).

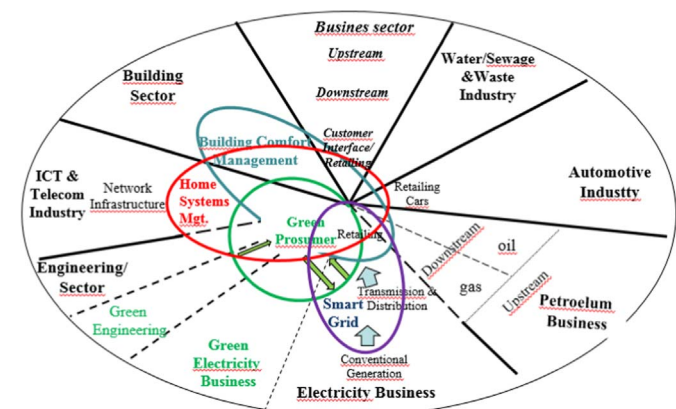
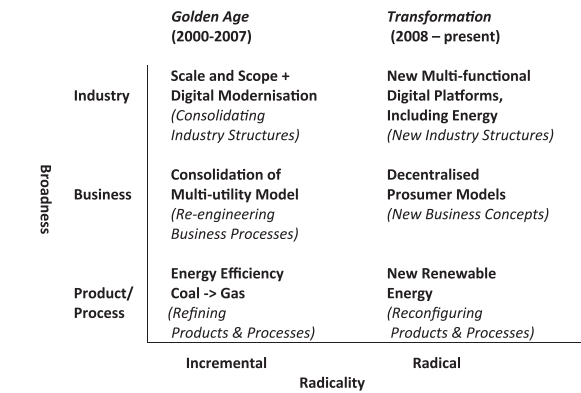


Fig. 16. Emerging customer-centric models, a summary.





Elaboration inspired by Hammel (2000)

Fig. 17. Reconfiguration of the European Energy Industry.

This development has taken place against the backdrop of extensive economic, political and technological change. The financial and its following industrial crisis did not only affect the energy market by lowering demand, which entailed a supply surplus leading to price decline. It also imploded the EU emission trading market, thereby dramatically diminishing the price uplift of CO<sub>2</sub> costs on the electricity price. Massive subsidy schemes in core European countries have made green electricity available on a large scale. Digital solutions has facilitated access for new actors in new roles. Together these shifts have threatened the economic viability of existing generation capacity. The 2007–2008 financial crisis and its industrial repercussions triggered and accelerated this development. One of the conspicuous effect has been a downward trend in the European electricity prices (Fig. 18).

The two parts of this article has explored this development from different points of departure.

Part 1 of the article has followed the evolution of share value, business strategy and business models of a selection of large European incumbents. A core finding was that the complex interplay of factors that undermined traditional business models was too confusing to register at an early stage. The positive feedback from capital and energy markets was such that they reinforced ties to the old model. When share prices were skyrocketing and profit margins were soaring, there was little incentive to seriously question existing business models, and conventional strategies were upheld (Mintzberg, 1985). Only after the positive feedback loop had been undermined, incentives for transformation emerged. And only after the persistent failure of the traditional business model did a radically new business strategy evolve, in a trial and error based mode (Saravathy, 2009; Ries, 2011).

While most of the incumbents incurred serious share-value losses in the period following the financial crisis, some incumbents fared far better. When examining possible explanations behind these differences

in share value success, three indicators stood out: 1) the energy mix, 2) the business scale and 3) financial performance of European energy players in our case study.

Part 2, of this article has explored new and emerging green and digital players. Our study of green spinoffs and green energy-technology providers indicate that, as judged by the share price development, there is little doubt that specialization in green power has created added value. Both green subsidiaries of ENEL and EDP did far better than their mother companies, and a selection of green equipment suppliers had – on average – far better share value development than the incumbents.

With respect to emerging digital business models, we have not been able to measure economic success through share value development. For this group of companies, our analysis has therefore been explorative, aiming at understanding the logic of their business models: Our findings are that most of the emerging business models circle around the customer interface where various digital solutions allow more flexible interplay between consumption and production of energy, and/or between several service alternatives to fulfill basic needs for customer home comfort. Seen from an energy-sector perspective, they represent introduction of new platforms for service bundling, where energy is one of the core elements. At an early stage these platforms were largely controlled by new entrants from other sectors, with energy incumbents potentially reduced to one of many service providers that the platform can combine in various ways tailored to customer need. However, conventional energy companies have increasingly engaged to exploit new market opportunities and may be in the process of catching up in some important areas.

## 8.2. Policy implications

The dramatic shift in business conditions for the European energy industry and the emergence of new business models has strongly been influenced by public policy, but also carries important policy implications in at least four important public policy fields: competition policy, storage and system balancing policy, grid policy, as well as innovation policy.

### 8.2.1. Competition policy challenges: from scale and scope to networks and platforms

From a competition policy point of view, we have seen a shift from challenges of scale and scope towards challenges of networks and dominant platforms. The network-logic of the new emerging business models entails a race for positioning as the dominant platform provider. Holding platform control is attractive, because it allows the actors to dominate the customer-interface, as well as to set the standards for industrial suppliers, while charging both sides (Baldwin and Clark, 2000). While in an emergent stage there is extensive rivalry

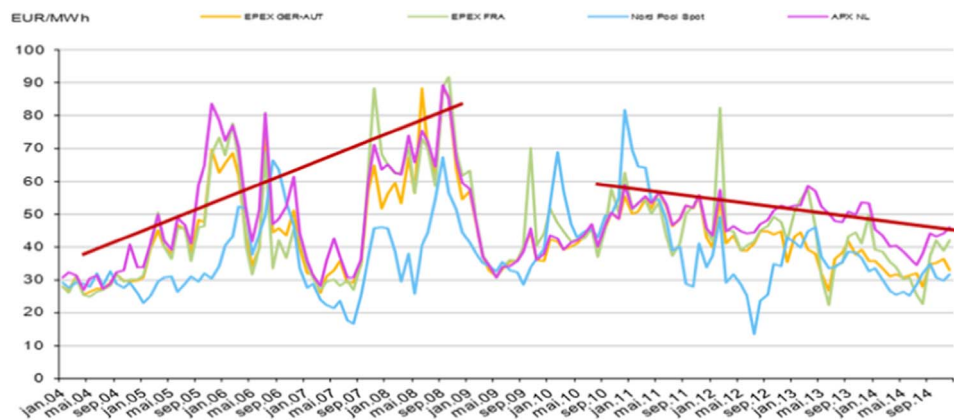


Fig. 18. Monthly Spot Prices for Electricity in Europe. (Source: Nordpool, 2015)



between many contenders for platform control, at later stages of consolidation, dominant platform positions may easily become a new source of oligopolic/monopolic control that requires public regulation on par with the scale and scope strategy of the conventional energy industry.

### 8.2.2. Policy for storage and balancing of intermittent renewables supply

The subsidies to renewable energy, together with rights to flexibly sell and buy from the grid, have allowed a surge in renewable energy generation. As indicated in the business models of new actors like Sungevity, but also innovative units within incumbents like E.ON, this growth of decentralized production from both power generators and prosumers implies a greater need for storage and balancing capacity. The policy approach to deal with these issues is, however, debated. On the one hand, there is a request from the incumbent industry for policies of investment support for supplementary capacity.

On the other hand, there are initiatives to secure supply stabilization bottom-up. As previously noted, Sungevity engaged in a partnership with Sonnenbatterie, Europe's leading smart energy storage provider, to offer smart energy storage systems to its network of customers in the U.S. and Europe. Yet a third way to deal with imbalances would be to strengthen the interconnections between markets, so that surplus in one region can balance deficits in another, or storage in one region may balance intermittent supply in another.

### 8.2.3. Grid regulation policy

Both rights for decentralized electricity generation and for new centralized intermittent renewable energy supply raises important grid-policy issues. As self-generation (prosumership) increases grid costs will be distributed over smaller energy volumes delivered through the grid. Grid costs may then escalate for remaining customers, if some payment is not charged from intermittent self-generators. Public policy will here have to strike a careful balance to secure functionality across old and new energy systems.

### 8.2.4. Innovation policy: telecoms as a harbinger

Compared to the telecoms sector, electricity has for a long time been technologically and commercially stable. While the competitive challenge in electricity in the 1990s and early 2000s was seen to lie in scale and scope along a well-developed technological trajectory, the telecoms sector was in the same period exposed to several technological quantum leaps - from fixed to wireless; from specialized telecoms platforms to general internet etc.; with dramatic consequences for leading players like Ericsson and Nokia. With decentralized green energy combined with digitalization, the world of energy in advanced European markets has entered a period of dramatic transformative innovation, whose outcome is as exciting as it is unknown. Yet the change itself also entails a new regulation policy agenda with a need for a more dynamic and iterative/negotiated approach to balance public and private interests. The more energy industry, like telecoms before it, develops novel business models that combine products and functions in new ways, the more capable must public policy be in combining the need to stimulate welfare enhancing innovation, while at the same time protecting the public interest against exploitation.

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