Experiences from Germany

Sustainable investment decisions by medium sized power producers

Municipal utilities are an essential constituent of the German power sector and currently strongly expanding their generation capacities. Multiple factors influence these investment decisions. Are these investments more sustainable than those of other power producers, and what could be done to make them greener?

By Volker Barth and Bernd Siebenhüner

The power sector is in many ways different from other sectors in the economy. Most of these peculiarities are linked to the difficulty to store electricity, the resulting necessity for supply to match demand in every instant of time, or the required distribution networks. The economic characteristics are partly linked to these properties, but are extended by the essential role of electricity for production and services. Keywords in this context are security of supply, market power, resource use, long investment cycles, and adverse external effects. In effect, the electricity sector is a classical example of a natural monopoly, where pareto-optimal self-regulation by market forces alone is hard to achieve, making the electricity sector prone to governmental regulation efforts.

From an environmentalist perspective, electricity generation is a major source of greenhouse gases. In 2007, power plants emitted 38 percent of the annual CO_2 emissions in Germany (UBA 2009a, b). This reflects, on the one hand, the importance of electricity generation within the energy mix, nearly 34 percent of the primary energy processed in Germany is used in power plants (AG Energiebilanzen 2009a). It reflects on the other hand the high share of more than 85 percent that fossil fuels still have in electricity generation (AG Energiebilanzen 2009b). Changes in the power sector are thus a key element in all strategies to reduce greenhouse gas emissions in order to limit climate change.

Changes in the power sector are also required from a purely technical perspective. More than one third of the German plants are older than 30 years and thus reach the end of their technical lifetime (Kjärstad/Johnsson 2007). The agreement on nuclear phaseout aggravated this situation and consequentially the country saw a wave of investment and even more announcements to invest. Interestingly, 97.5 percent of these newly constructed plants are fossil-fuelled and thus do not at all resemble the trend of the past decade towards renewable energy sources (RES), particularly wind (Kjärstad/Johnsson 2007). It also appears to stand in stark contrast to the greenhouse gas emissions targets of both the European Union (EU) and the Federal Government. Among the planned investments, however, the trend towards wind is still vivid.

Given this apparently confusing picture it is worth while asking what actually drives actors and investments in the power sector. If the leading principle were only profit maximization, as simplistic textbook economics might suggest, the recent switch to coal and gas could hardly be explained (Pahle 2010). In fact, the numerous political, societal and environmental demands sketched above make the electricity market everything but a free market. In order to understand the investment behaviour in the power sector one therefore needs to ask who is actually doing the investments, and what are the reasons for them to invest and to choose specific technologies? In particular one might look at the roles that political, cultural or other factors play. And, in an even greater deviation from textbook economics, one is led to ask with behavioural economists like Gordon and Kammen (1996) or Patt and Dessai (2005), just how rational the procedures actually are, that form the basis of the risk assessments that underlie investment decisions.

In this study, we take a bottom-up perspective and take a closer look at the motivations for individual power producers to invest as well as the factors and risks that they actually consider. Our focus is on municipal utilities (MUs), since these are the actors who are most affected by all forces that govern the German power market. We present first results from a series of in-depth interviews with representatives from MUs across the full MU size range, who recently invested in a variety of technologies. The next two sections provide a brief sketch of the position of MUs within the power market and a description of our study design. Our results address the following questions: What are motivations for MUs to invest? What role do environmental issues and RES play? What factors and risks have actually been considered in recent investment decisions? Based on these findings we will also ask what roles MUs could play in the process of restructuring the electricity sector and what kind of policy support would be required to support this.

Municipal utilities

In Germany, 604 municipal utilities deliver electric power to end customers, 367 of which operate own generation capacities (VKU 2009). They provide a total capacity of 11.3 GW or some 9 percent of the German capacity (VKU 2009, Eurostat 2009). Despite this small share in generation, MUs still play an important role in the power sector, since they deliver almost 57 percent of electricity to final customers, which means that they pass huge amounts of electricity from other generators through to final customers, mainly households and small industry (VKU 2009). Installed capacity per MU is highly variable, ranging from few kilowatts to several hundred Megawatts in big cities. Noticeable is the predominance of combined heat and power (CHP), which amounts to 84 percent of installed MU capacity (VKU 2009). Given the high energy efficiency of CHP this is a first indication for sustainability aspects in power generation by MUs.

These companies are neither big enough to exert significant market power like the incumbent "big four" integrated utilities in Germany who operate some 80 percent of the German capacity, nor are their revenues virtually guaranteed under the German Renewable Energies Act (EEG) of 1990, as is the case for the numerous small independent power producers who operate RES plants. The fourth big actor group, the industrial autoproducers are hardly present on the market. In contrast to that, the intermediate size and diverse generation structure of municipal utilities make them the closest approximation to price taking market actors that currently exist on the German power market. This makes them the actor group that fits best to the purpose of our study.

On the other hand, one might argue that their status as largely publicly owned enterprises precludes municipal utilities from being normal market actors. As it is the explicit purpose of MUs to provide services of general interest to virtually everybody, their operation occurs within a societal and social context, which makes influences from local politics obvious and virtually inevitable. On the other hand, more than 50 percent of German MUs are already organized as limited liability or incorporated companies, even though usually the city or community still holds the majority (VKU 2009). In any case, the resulting proximity to local politics makes the business model of MUs somewhat special and limits international comparison.

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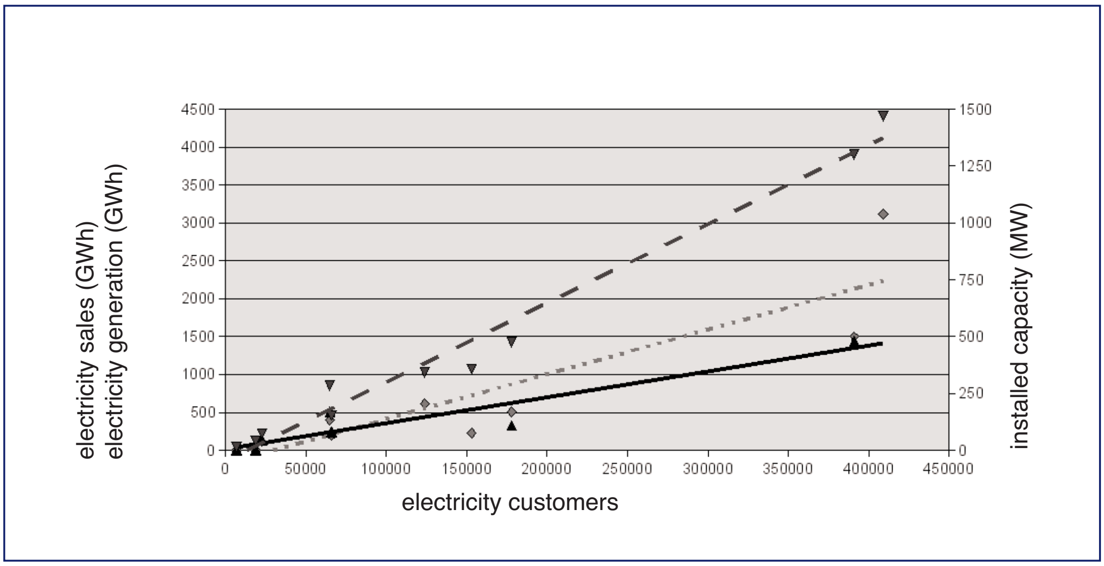
One final aspect is the long experience of MUs in decentralised power generation, which is seen by some as an essential property of sustainable energy systems (Richter/Thomas 2008). Decentralization occurs on two levels: on the first level MUs provide generation capacities in many cities and communities across the country; on the second level this capacity is typically distributed across the city or community. This results in relatively small units for which there exist various technology alternatives, not only the few suitable for large, centralized plants. While this has the positive side effect, that production can be easily diversified such that security of supply increases, it also increases the likelihood that RES are utilised.

Study design

The empirical basis for our study are ten guided in-depth interviews with leading representatives of municipal utilities virtually across the whole size range of German MUs (see figure 1). The only two criteria for selection were that the MU ➜

Figure 1: Electricity sales (downward triangles), own generation (diamonds) and installed capacity (upward triangles) in relation to the power customers of the interviewed municipal utilities



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operates own generation capacities and that the equity share of the city or community exceeds 75 percent. All MUs are organized under private law: eight as limited liability companies (GmbH), two as stock corporations (Aktiengesellschaft). All interviewees have been involved in decisions on significant investment in power generation capacities over the past five to ten years and were typically chief executive officers, other members of the managing board, or heads of the technical or company development departments.

Interviews were conducted face-to-face with one or two interviewees, took place between March and September 2009 and typically lasted 90 to 120 minutes. All interviews have been tape-recorded, fully transliterated and later on evaluated using the maxQDA software. The results presented below are derived from an initial semi-quantitative analysis. Of course, the small sample is not sufficient to be considered as representative. However, since the companies in the sample cover virtually the whole spectrum of the MUs in Germany, it may still give a fairly good impression of the overall situation.

Conceptually, the study was inspired by behavioural economics. The general motivation was to find out about motivations and drivers behind investment decisions, in particular in relation to renewable energy or high-efficiency technologies such as CHP. We sought to analyse biases in decision making behaviour that deviate from a conventional rationalistic notion and would require novel explanatory pathways. In particular, we were interested in understanding collective decision making in medium-sized companies in the German electricity sector and whether behavioural economics findings could be reproduced also with larger collective decision making bodies, such as MUs.

Motivations for investment

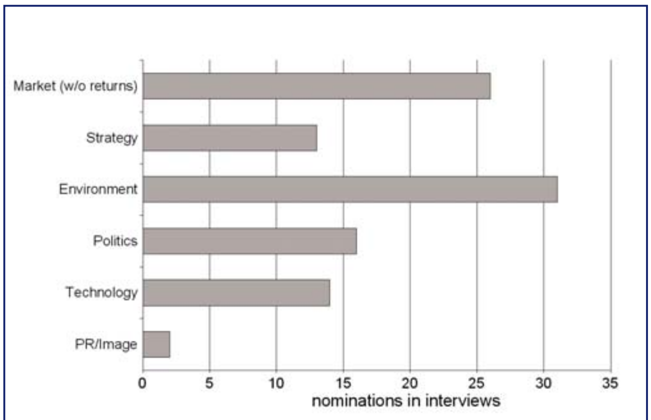
In a first step, the interviewees reported on their motivations to do investments during the past five to ten years. The answers fell into six broad categories. Figure 2 shows how often items belonging to any of these categories have been mentioned during the interviews.

It came with little surprise that the first big block of answers covered market issues. Since we assumed that no investment will be undertaken that is not expected to deliver a positive net present value, the market bar in figure 2 only covers other factors related to the market position of the company. For example, investments have been motivated in order to diversify production, to avoid high fuel prices by choosing another technology, or to participate in growing markets. A second group of motives can be attributed to the strategic orientation of the company. The distinction we make between market and strategic motivations is that the former are mainly reactions to external forces, while for the latter the company has an internal impetus. Examples are the motivation to be independent from suppliers or to decentralise production. If we combine market and strategic motives, these economic motivations form the largest category of motivations.

More surprising is the great importance of environmental motivations, which covers both more sector-specific issues like climate change and energy efficiency as well as more general topics like sustainability or environmental protection. This highlights the great awareness of MUs for environmental issues.

Motives that can be attributed to the categories politics and technology are less prominent among the interviewees. The medium importance of technology is quite understandable for interviewees whose occupation is to run the whole company, for which technology is merely a means to an end. One might have expected a much more prominent role for political factors, given the high political relevance of power generation. In fact, political instruments like regulation or support for RES play a role, but since their purpose is to influence the market or the environment they have rarely been mentioned explicitly during our interviews. Other political factors like experienced pressure from public or political groups or the existence of environmental targets set by local politics have only been relevant for few interviewees.

Figure 2: Groups of motivations to invest. Bar length indicates the absolute frequency of motives that belong to any of the six categories shown.



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Technology choice

A great part of each interview was devoted to a detailed discussion on a particular investment decision of the company within the past five years or so, and in which the interviewees have been involved. In case of more than one investment projects, the interviewed persons were asked to select one of their choice. The technologies in these selected projects are listed in the middle column of table 1, while the right column lists projects that were also conducted during that period and have been mentioned by the interviewees, but have not been discussed in greater detail.

Like in the nationwide picture, energy-efficient cogeneration and CHP plants dominate the technology choice also in our sample, both for the selected and the additional investment

Table 1: Technology of investment projects selected by interviewees for in-depth discussion in the interviews and of additional investment projects. RES technologies are blue.

Technology	Selected Projects	Additional Projects
Gas and steam (cogeneration)	3	--
Waste/wood incineration (cogen.)	2	1
CHP (landfill/natural gas)	2	6
CHP (biomass)	1	6
Gas and steam (condensation)	1	2
Photovoltaics	1	1
Wind	--	6
Hard coal (slice)	--	1

Source: own

projects (VKU 2009). Among the projects selected for discussion dominate large cogeneration plants. Within the group of additional projects smaller CHP plants are most abundant, fuelled either by biomass or by natural or landfill gas; but also wind plays a role.

Given the typical and reported plant sizes associated with these technologies this indicates that usually the biggest projects have been selected for discussion, even though the environmental benefits of large cogeneration plants only relate to their energy efficiency, thereby requiring less fuel and emitting less carbon dioxide as compared to separate heat and power plants. The fuel switch towards RES usage occurs mainly among the smaller additional investments that have not been discussed in detail.

Reasons for this are twofold. First, path dependency is striking: particularly the larger MUs have operated large plants for decades, they own the sites and the infrastructure, and they often also have to supply district heating. Under these circumstances it is quite natural to refurbish and upgrade the existing plants in order to be more efficient and meet recent environmental standards. Switching to other fuels or even other technologies like RES would mean to write off huge amounts of sunk cost and require large investments in infrastructure and is thus done only rarely and gradually.

The other aspect is reliability. Even if there were another technology that could be used rather similar to the existing one, like biogas in replacement for natural gas, it could be difficult to provide the required quantities as reliably as before. It would also imply to pursue unusual pathways or use new, rarely tested technologies, which conflicts with the preference for proven technologies stated by several interviewees.

As a result, many large plants are running relatively climate-friendly, but still conventional, state-of-the-art cogeneration technology. Even though there have been other interview partners who aim to maintain a strategic pioneering role, new technologies are mainly found in the smaller investment projects, where failures have less severe impacts for supply and revenues.

Factors involved in investment decisions

In order to address the factors that have actually been involved in the decision making process interviewees were asked to sort a predefined list of factors according to their importance for the investment decision. For the analysis, the factors were again categorised according the same categories as for the analysis of the motivations for investment. The average importance of each group was then calculated by averaging the ranks of importance of all n factor nominations within each category (see figure 3).

The results are generally in good agreement with the expressed motivations, even though market factors are now slightly more important than environmental factors. Note that we have separately and explicitly asked for the role of reliable revenues, which is also quite important for each of the interviewed MUs, while strategic factors are less important. Apparently, market and economic factors have comparable relevance for investment decisions, and each MU mentioned at ➜

Figure 3: Average importance (1=most important, 5=least important) of factor categories relevant for investment decisions. n indicates the number of factor nominations in that category

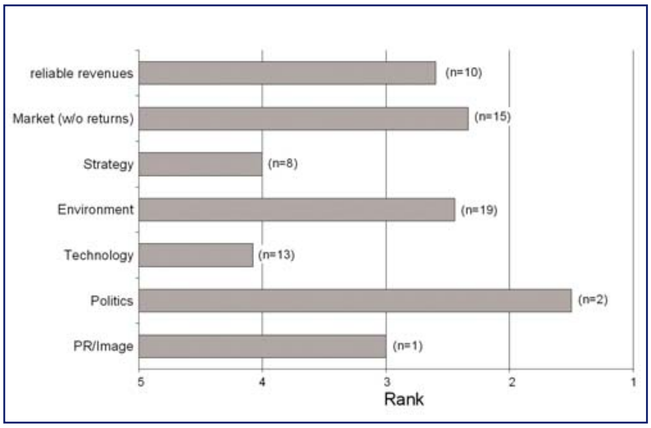

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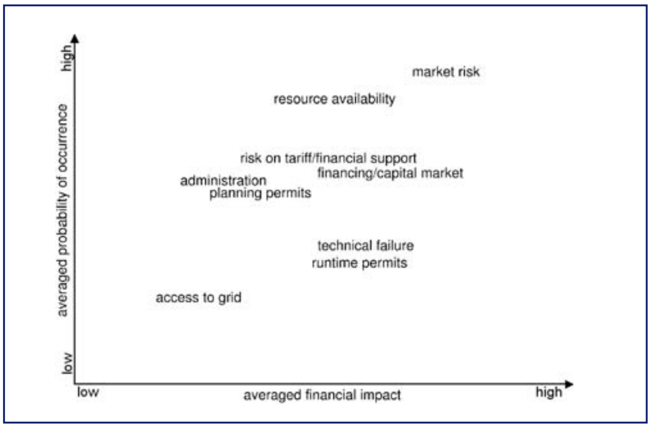
Figure 4: Averaged risk perceptions for the selected investment projects with respect to financial impact and probability of occurrence.



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„If public relations issues are relevant in investments descisions, they could be critical."

least one factor that fell into the categories market and environment, respectively. In contrast to that, technological factors are also considered during the decision process, but are generally only of minor importance.

Note that the categories politics and public relations/image appear to be much more prominent in figure 3 than in figure 1. Both figures are. however, perfectly consistent, since figure 1 shows absolute nominations, while figure 3 shows the relative importance within each category, and both the politics and public relations/image category have only one or two nominations. The point is that politics and public relations/image issues do not play a role in general, but when they become an issue in the decision making process, they can be highly, even critically, important for the whole project.

Risks involved in investment decisions

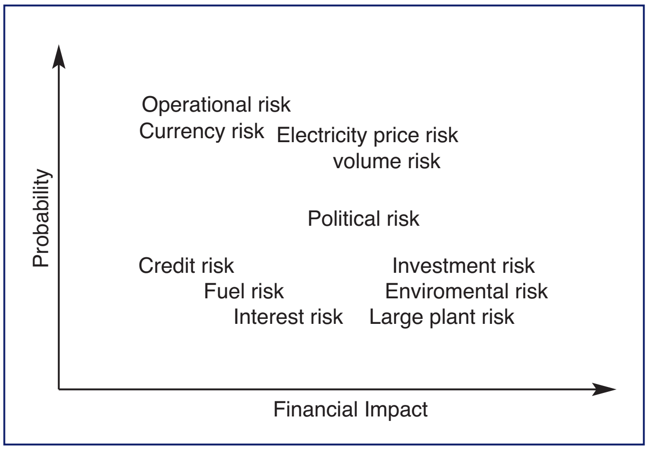
Likewise, we addressed the impact of perceived risk on the decision-making process for the selected projects. Again, the interviewees were asked to arrange risks from a predefined list in a two-dimensional scheme along the dimensions probability of occurrence and financial impact. Assessment for both dimensions should be given qualitatively, ranging from low to high.

For the semi-quantitative analysis a scale ranging from 0 (low) to 1 (high) was superimposed on the qualitative axes, so that the coordinates of each risk could be determined by linear interpolation. Figure 4 shows the averaged coordinates for each risk across all interview graphs. For convenience, the axes have again been assigned qualitative labels. Obviously, market risks are perceived as most significant with both high financial impact and high probability of occurrence. This is quite reasonable for price-taking actors without market power. A similar reasoning applies for resource availability, which also includes the risk of fuel price variations, which can hardly be foreseen, nor does there exist a good method of hedging it. Remember that except for the PV plant all selected investment projects required fuels that had to be purchased on the market.

The risk in tariff/financial support and the risk in the financial market form a second group that features medium to high financial impact and medium to high probability. This reflects the often expressed insecurity about possible changes in support schemes for RES and cogeneration, since those MUs that utilized cogeneration/CHP plants received support via the German CHP Act of 2002. Likewise, financing conditions on the capital markets are highly relevant for the interviewed MUs, since most of them depend on project financing and bank loans for large projects. However, although this risk was highly relevant during the first interviews in March 2009 at the peak of the so-called financial crisis, its importance decreased until the late summer. The position of the financing risk in figure 4 could therefore also be the result of that singular event and should thus be treated with caution.

Political risks such as acquiring permits in the planning phase of a project and renewing them during runtime are considered to be medium. Here, the relative transparency of permit issuing processes comes to play, as well as the often long experience of the responsible persons within the MUs with these processes. Of course, the risk of not getting a permit is higher for a newly started project in comparison to a running plant that has already been approved before. Vice versa, the financial impact is much higher when a productive plant is shut down because it fails to meet legal requirements. Technical failure of plants is generally considered to be of low probability thanks to experienced technicians in the companies and the preferred use of proven technologies. Like for a permit revocation for a running plant, the financial impact of a technical failure can be quite large. In contrast to that the perception of administrative risk, that is the risk of problems in the internal management of an investment project is considered to be quite likely, albeit with small financial impact. Problems related to getting access to the grid are not an issue here, since all interviewed MUs own their local grid. This is different from the situation of the independent power producers, particularly for those that operate RES

Figure 5: Probability and financial impact of risks as perceived by Vattenfall.



Source: Vattenfall 2006

plants, where grid access ranges among the highest risks (Cleijne/Ruijgrok 2004, Ragwitz et al. 2007).

Risk comparison

To see whether the risk perception of MUs differs from that of other actors in the power market, we compare figure 4 to a similar graph (figure 5) that has been included in the annual reports of the integrated Supplier Vattenfall with very little variation for some years (Vattenfall 2006). After accounting for the different nomenclature, both graphs appear to be quite similar. The market risk of the MU graph translates to an electricity price risk in the Vattenfall graph, similar pairs are administration and operational risk, planning/runtime permits and political risk as well as technical failure and large plant risk. Each of these pairs is located in comparable sections of the graph, indicating that risk perception of MUs on average does not differ significantly from that of bigger players in the market.

There appear to be two exceptions to that general similarity of both graphs. The first is the perception of the financing/capital market risk, which is quite prominent for MUs, whereas the apparently similar risks on currency, on credit and on interest are less important for Vattenfall. Apart from the probably overstated role in the MU graph due to already discussed effects of the financial crisis, the risks in the Vattenfall graph refer to Vattenfall's role as a transnational company and the risk that customers fail to fulfil their obligations. These risks are not related to third party project financing, which is less important for a large company such as Vattenfall, who can finance even power plants from balance sheets.

The other difference relates to the perception of the resource/fuel price risk, which is one of the most prominent risks for MUs, while it is of minor importance for Vattenfall. This difference is directly related to the roles of MUs and Vattenfall on the energy market: while MUs are small price-takers, Vattenfall can exert its size and market power in order to keep price risks within limits.

Risk perception

The risk graphs in figure 4 and 5 differ remarkably from what economic and management textbooks tell us. Following textbook wisdom it is clear that the probability of occurrence of risks should fall as the financial impact of the risk increases. High probabilities of occurrence are acceptable in early stages of project development, as long as not much money has been spent. When the process evolves and more money has been used on the project, risks must become less likely to be acceptable. Thus, in a graph like in figure 4, risks should lie on a line with negative slope that falls from top left to bottom right.

However, neither the MU, nor the Vattenfall risk assessment follows this theoretical pattern. In both graphs, risks do not exhibit a clearly visible trend. In fact, a linear regression of the MU data yields a line with positive slope that increases from lower left to top right, although the correlation is rather weak and therefore not shown in figure 4. But why is there no clear correlation? As for the MU graph one may argue that it consists of averaged values for each risk and that the correlation got lost during the averaging procedure. But the graphs for the individual MUs give no clear picture, either. In cases where data are clearly correlated, some have negative and some positive slopes. And some are as weakly correlated as the Vattenfall graph so that the averaging argument fails.

„The recent debate on revoking the nuclear phaseout in Germany is clearly counterproductive, when improving the position of municipal utilities."

Apparently, real-world risk assessment is more complex. One explanation may be that possibilities to mitigate risks are quite limited. In particular market risks are beyond the control of any single company and thus fall beyond the logic of management theory. Our findings may also be the result of a systematic bias in risk perception and related to a non-rational bias in economic behaviour.

Conclusion

Our study clearly shows that municipal utilities are subject to a number of non-economic influences when investing in capacities for power generation. In decision making, expressed environmental motives are almost as influential as economic ones, even though MUs generally do not act as first movers. Thus, they prefer highly efficient but proven technologies like cogeneration, while RES are generally left for smaller sites that are less important for the company's economic well-being. Risk perception is dominated by market and resource availability risks, which prevail as hardly controllable given the market position of MUs.

In order to improve the current position of MUs and to make their investments even more positive for the environment, political support for RES and CHP/cogeneration needs to be sustained and combined if possible. Clear and stable political targets can help to reduce risks significantly. The recent debate ➔

on revoking the nuclear phaseout in Germany is clearly counter-productive in this respect. Another possibility could be to support technology programmes that speed up the establishing of innovations into state-of-the-art technologies.

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AUTHORS + CONTACT

Dr. Volker Barth is researcher and ***Dr. Bernd Siebenhüner*** is professor at the Chair of Ecological Economics at the University of Oldenburg.

University of Oldenburg, Department for economics, business administration and law, 26111 Oldenburg

Email: volker.barth@uni-oldenburg.de