Self-Restraint and Sufficiency of a Steel Processor

Countering the Corporate Rebound Effect

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Abstract *Based on an in-depth case study analysis, the chapter discusses whether and to what extent companies that limit their growth and resource use through sufficiency can avoid rebound effects at the firm level. It also identifies entry points for companies and policy makers on how efficiency measures can contribute to absolute resource reductions rather than accelerating growth.*

1. Introduction

The growth economies of the global North are failing to reduce their environmental impacts and consumption to the extent that would be ecologically necessary and globally equitable (Parrique et al. 2019). Technical efficiency and consistency measures are proposed to achieve the necessary reductions by dematerializing and ecologizing economic activity. However, as long as growth- and profit-driven exploitation interests determine the use of nature, the gains often flow back to other uses in so-called "rebound effects" (Herring/Sorrell 2009). Rebound effects in a micro-economic context (as opposed to on the scale of the national economy) can take different forms, including economic or psychological (Santarius/Soland 2018). For economic rebound effects, an increase in efficiency might lead to lower costs, thus the consumer might use the additional money for further consumption. For psychological rebound effects, the more efficient product might be perceived as less harmful to the environment and may be used more intensively. Consumers may also feel that they can act in a less environmentally responsible way. As a result, resource consumption may ultimately increase.

How can this be understood at the firm level? The problem of rebound effects has been primarily located in household consumption (Greening et al. 2000; Sorrell 2007; Santarius 2015). Research analyzing production-side rebounds, their manifestations and causal relationships has been limited (Figge et al. 2014). However, the literature suggests that companies are far from realizing their full efficiency po-

tential: They do not identify or implement possible measures – the so-called "efficiency gap" (Solnørdal/Foss 2018). Alternatively, when efficiency measures are implemented, they often do not have the desired effect: the environmental impact is instead shifted to upstream or downstream stages of the value chain (burden shifting); producing the equipment for the efficiency measures is itself resource-intensive (embodied energy); and the planning and implementation of the measures are flawed (Schöpflin/Lautermann submitted). Wüst et al. (2023) developed a typology for rebound effects in firms based on the existing literature (e.g. Jenkins et al. 2011; Santarius 2015; 2016):

- Output effects, which result from increasing production and sales to penetrate and develop markets;
- Factor substitution effects, which result from the replacement of production processes and the associated increase in the use of energy services;
- Re-utilization effects resulting from performance-enhancing changes in production processes and production organization;
- Re-design effects resulting from performance-enhancing changes in product design;
- Re-spending effects resulting from the use of saved additional financial resources for regular current expenditures;
- Reinvestment effects resulting from the use of accumulated financial savings for product development, product differentiation or diversification;
- "Frontier" effects resulting from the development of entirely new products and services.

These rebound effects can occur due to (i) strategic priorities, (ii) cognitive and institutional factors and (iii) psychological factors.

Firstly, in terms of strategic priorities, environmental resource savings are often not the focus of efficiency measures but rather a means to other ends. Efficiency gains are then partly or fully diverted to these other uses (Schöpflin/Lautermann submitted). In doing so, companies often follow norms and routines of competition and growth, especially if they perceive high productivity and cost pressures in their industries (Wüst et al. 2023). Ecological problems, on the other hand, are seen as subordinate or even conflictual. This gives rise to a strategic rationale for companies to invest efficiency gains in the expansion and differentiation of production, in automation, performance enhancement or process quality improvements (Gebauer 2022).

Secondly, rebound effects also arise from deficits in knowledge and information management (Wüst et al. 2023). Rebound risks cannot be identified and countered if information is lacking on consumption data, life cycle costs or the extent of material and financial gains from an efficiency measure. Environmental management and

financial controlling tools to provide this information are rarely implemented and used with the required level of detail (Lautermann/Schöpflin 2021).

Thirdly, similarly to psychological rebound amongst consumers, rebound effects also occur in companies as a result of psychological reassessment and relief (Wüst et al. 2023). With an efficiency measure, the technology, process or overall behavior in the company may be considered less harmful to the environment. This may lead employees and customers to use the technology more intensively or to question their own responsibility for energy- and material-saving behavior. If they change their behavior as a result, resource consumption could ultimately increase.

The rebound effect caused by strategic priorities, in particular, is seldom given a critical reflection. On the contrary, (intended) growth made possible by increased efficiency is seen as a success and not as a negative impact of the measure (Behrendt et al. 2018). This framing neglects the environmental impacts of expanding production and sales and is a barrier to closing the gap between required absolute resource reductions and the delivered relative solutions. Rebound effects characterize (business decisions in) growth economies and systematically prevent decoupling of economic growth from environmental pollution and consumption, a prerequisite for green growth (Parrique et al. 2019; Hickel/Kallis 2019).

With few exceptions, there is little data on the micro-economic rebound effect of energy efficiency programs in a single company. Konash and Nasr's (2022) calculations of the rebound effect in a single firm suggest that energy efficiency programs have limited ability to realize their full energy savings potential and reduce energy use over time. It is therefore considered crucial to look beyond efficiency measures and selectively reduce production and consumption levels through sufficiency, a concept of absolute "enough" that aims to prevent rebound effects (Schneider et al. 2010; Herring/Sorrell 2009; Best et al. 2022) and that complements the weaknesses of efficiency approaches (Dyllick/Hockerts 2002).

In this chapter, we discuss whether companies that limit their growth and resource consumption through sufficiency can avoid rebound effects at the company level: To what extent can a sufficiency-orientation in a firm avoid micro-level rebound effects? To answer this question, we discuss the case of Richard Henkel GmbH, a small manufacturing firm that combines a strong efficiency orientation with self-restraint and sufficiency in the setting of a resource-intensive and competitive sector. We use three efficiency measures to show how it deals with efficiency gains and associated rebound effects. The example shows the potential for absolute savings when environmental benefits are prioritized and growth is subordinated. However, it also shows the limits of micro-level agency and effectiveness within the growth economy. In the conclusion, we draw lessons and recommendations for companies, multipliers and policy makers.

2. Rebound prevention through corporate self-restraint and sufficiency?

Generally speaking, sufficiency, as a "principle of self-restraint" ("Prinzip der Selbstbeschränkung", Sachs 2015: 2), means reducing resource and energy demand and finding a measure of "enough" that ensures what is needed. It thus aims to avoid both over-consumption and under-provision (Fuchs et al. 2021). To achieve this, sufficiency relies on an institutional change (Kropfeld/Reichel 2021) and a fundamental change in values and behavior. Other strategies, such as efficiency and consistency require this only to a limited extent, so that only a sufficiency shift can break with the paradigm of exploitation and growth still inherent in the other two (Martínez-Alier et al. 2010). Sufficiency is therefore often seen as the least relatable, represented and implemented of the three sustainability strategies: it appears fundamentally at odds with consumer, political and corporate interests. It is also still less present in policy debates (Zell-Ziegler et al. 2021), even though it is gaining visibility (e.g., the 2022 French Energy sobriety plan). Sufficiency is also increasingly discussed in research (Sandberg 2021) and has been presented as a business strategy to promote and enable sustainable consumption (Niessen/Bocken 2021).

Sufficiency at the business level is understood as companies not only promoting sufficiency-oriented lifestyles but also reducing or limiting their own resource consumption and production volumes (Jungell-Michelsson/Heikkurinen 2022). While most current research investigates the role of businesses in promoting sufficiency (Bocken/Short 2016; Niessen/Bocken 2021), mainly by marketing means (Gossen et al. 2019b; Gossen/Kropfeld 2022; Kelleci/Yildiz 2021), research on sufficiency in production is still rare. Instead of striving for growth, firms can strive to maintain their productive capacity and become non-growing firms (Liesen et al. 2015). Beyeler and Jaeger-Erben (2022) look into the practices of businesses that are willing to operate at smaller organizational scales and pursue sufficiency. Bärnthaler and Gough (2023) conceptualize production corridors, which meet essential needs without excess production. Degrowth advocates even call for a renunciation of sales, profit maximization and market power (Deimling 2016; Khmara/Kronenberg 2018; Nesterova 2020). The importance here is not on limits and savings per se but rather on a new perception of values and well-being, human needs and natural resources, and the pursuit of qualitative change. A redefinition of business values would be moving from the primacy of profit to the primacy of purpose (Mayer 2020). Moreover, degrowth-oriented companies emphasize their attitude, ability and willingness to reflect and to learn to change (Froese et al. 2023). They develop and reinforce a qualitative understanding of success with ideas about an appropriate size (usually a corridor) and growth rate. In order to achieve and maintain their appropriate size, the entrepreneurs examine their decisions in terms of the growth effects they generate (Gebauer 2018). A deliberate decision to forgo growth is not necessarily aimed

at improving environmental performance (Liesen et al. 2015). However, when land and building space, machine capacity, suppliers, investment, customers, sales, distribution channels, transport routes, etc. are constrained, limits for environmental impacts and consumption emerge 'naturally' (Gebauer 2018). Entrepreneurs who explicitly justify their self-restraint with societal embeddedness evaluate decision options in terms of social and environmental costs. They may refrain from financially promising actions that would have a negative impact on others or invest in precautionary measures (Deimling 2017).

Therefore, an orientation towards sufficiency and self-restraint in a business could change the context of efficiency improvements. Savings from efficiency measures are not (automatically) invested in expanding capacity, performance, automation or output but rather in reinforcing impact through more eco-effective use of the savings (Gebauer 2022). Sufficiency-oriented business might therefore be better able to avoid rebound effects of efficiency measures, by reinvesting savings in impact instead. To support these thoughts empirically, we turn to the case study.

3. Case Study: Richard Henkel GmbH

The case study was part of the German research project "Holistic Management of Energy and Resource Efficiency in Companies".[1] The project investigated rebound effects in companies both conceptually and empirically. In addition to a baseline survey of medium-sized to large companies and company workshops, practical insights were gained through in-depth case studies in ten companies from different sectors. Based on the findings, recommendations for action were developed for companies, multipliers and policy makers (Wolff et al. 2022; 2023).

While the case studies were comparative, this chapter focuses on Richard Henkel GmbH (referred to as Henkel in the following). From November 2019 to July 2021, the first author conducted three rounds of on-site and online interviews with Henkel, with a total of five interviews. In the first round, preliminary research and a site visit informed the selection and analysis of efficiency measures; in the second round, potentials and drivers for rebound and reinforcement effects were explored. In the third round, supplemented by written and telephone follow-ups with the business owners in 2022, the findings and recommendations for rebound management were

1 The project was funded by the German Federal Ministry of Education and Research (BMBF) as part of its programme "Research for Sustainability" (FONA). Project partners included Oeko Institut, Institute for Ecological Economy Research (IÖW), Leuphana University (Centre for Sustainability Management), Data Center Group (DCG) and the business association B.A.U.M. e.V.

discussed. Interviews were conducted in German and quotes were translated into English by the first author.

The interviews followed semi-structured questionnaires and were recorded and analyzed in accordance with the templates developed by the project. At Henkel, the interviewees were the two managing owners (MO 2019, MO 2020, MO 2021, MO 2022) and the heads of the two business units (HF 2021, HC 2021). Other sources included the company's Sustainability Reports (SR), EMAS Environmental Statements (ES) and existing research on the business (Deimling 2016; Gebauer et al. 2015). The descriptions are based on the interviews and sources provided by Henkel, unless stated otherwise.

3.1 The company

Henkel is a small owner-managed German steel and metal processing company, established in 1922. Its first business unit manufactures and sells tubular steel furniture such as chairs, stools, tables and medical furniture to consumers and commercial customers, such as care homes for the elderly, clinics and wellness facilities. Its second business unit offers surface treatment services to industrial customers in aviation, automotive, medical and climate-tech industries. Finishing metal surfaces by grinding, blasting and powder coating accounts for around two thirds of Henkel's sales. Henkel's main suppliers are regional or European companies in the steel and plastics industries, as well as manufacturers of powder coatings, washing chemicals and packaging. The company has constantly retained a workforce of around 50, down to 45 in recent years, mainly due to a shortage of skilled workers. The annual turnover is relatively stable between €2.5 and €3.5 million, the annual income is about €250,000 before investments.

Richard Henkel, the founder of the company, focused on aligning the company's services with customer needs for functional and durable products. This included reducing the use of resources and making production as environmentally friendly as possible. Transparency and environmental protection have been explicitly anchored in the company since the 1950s (Deimling 2016). Henkel has been validated according to the Eco-Management and Audit Scheme since 1998 and has been a signatory to the Charter of the Business Sustainability Initiative of the State of Baden-Württemberg since 2015. Henkel aims to achieve an overall positive record across all areas of life cycle management and has received several awards for its environmental commitment.

Over the past twenty years, a wide range of energy efficiency measures and a switch to renewable energy have more than halved the company's energy consumption and CO_2 emissions, both in absolute terms and relative to sales. In addition to electricity and heat, the company has drastically reduced its material consumption. It has introduced closed loops and recycling systems in all its processes, from rinsing

baths to scrap metal and packaging. In its furniture unit, repair and refurbishment are increasingly replacing new production.

When Susanne Henkel took over the company lead in the 1990s, she sharpened the firm's environmental profile and not only set further limits on environmental impact and consumption but also on corporate growth itself (Deimling 2016; Gebauer et al. 2015). The latter was a particular response to the 2008/09 financial crisis and to the industry's strong market and price dynamics and dependencies. Susanne Henkel has since focused on what she calls 'inner growth', keeping capacities, employment and sales stable while constantly decreasing resource use and increasing circularity in all areas of the business. As such, and despite the fact that this is termed life-cycle management and efficiency within the company, Henkel could be seen as being guided by ideas of sufficiency or self-restraint: forgoing growth in favor of absolutely reducing environmental consumption.

3.2 Energy efficiency measures

Henkel's energy-intensive processes depend on the efficiency and stability of its production systems. Since 2005, three measures have been particularly relevant: the new insulation of the paint ovens, the renewal of the conveyor system and the replacement of the automatic powder booth. All were accompanied by substantial energy savings – reductions in actual or projected consumption increases – and represent Henkel's way of thinking: a consistent focus on savings and an unconventional search for solutions. The measures were necessary because of an actual or imminent deterioration in resource consumption data or because of an additional reduction opportunity in the course of replacement investments. All measures were implemented on the company's own initiative, explicitly going beyond the market standard.

Insulating the painting ovens (2005/2006)

Henkel constantly reviews data to determine saving opportunities: Where is the greatest consumption, unexpected deterioration or heavy wear and tear? Increased temperatures in the hall and frequent motor wear pointed to a problem in the walls of the ovens; thermal imaging cameras revealed the crumbling of the polystyrene insulation. As it could not be replaced, the oven manufacturer offered to demolish and rebuild the ovens or walls. To avoid this, Susanne Henkel used her network to find an insulation from the nuclear power plant sector and applied it to the outside of the ovens. This reduced heat radiation by almost 60 per cent, cut energy consumption by at least 30 per cent and extended the life of the motors. Lowering the temperature in the hall also improved working conditions for the employees. The €20,000 investment amortized in less than 1.5 years.

Improving the conveyor belt (2012)

The conveyor in the powder coating line needed to be replaced due to wear and tear. According to the company's internal guidelines, a new conveyor would have to use less energy. This was achieved through a redesign: products move through the system on supports to which they are attached. By using a high-strength but thinner material, the weight of the supports could be reduced, thereby reducing the energy required to move, heat and cool them. However, the conveyor manufacturer was reluctant to use the new material. Henkel decided to have the steel parts specially made and installed without the manufacturer. The extra cost of €4,000 was recouped in one year through savings in energy costs. The new conveyor, with lighter parts, uses 8 per cent less electricity and 12 per cent less process heat, which has also improved the working environment. The material will be used exclusively in both business units in the future.

Replacement of the automatic powder booth (2014/2015)

After 25 years, the powder booth needed to be replaced as spare parts were no longer available from the equipment manufacturer. Henkel realized that the current market standard would increase energy consumption by 60 per cent compared to the old booth due to increased automation. When the usual equipment manufacturers could not provide a solution, Henkel commissioned an SME to build a new powder booth that increased energy consumption by only 24 per cent. However, this smaller increase still worsened Henkel's energy-related productivity metric: the improvement is only relative to the projected deterioration. The investment cost was around €450,000 with an expected payback period of up to seven years.

(Rebound) effects of energy efficiency measures

All three efficiency measures resulted in significant reductions: either in actual or in anticipated increases of energy consumption and other parameters. However, lacking experience with the new solutions and data from the manufacturers, it was not possible to set specific targets beforehand – improvements were to be made "as far as possible" (MO 2019). It is therefore not possible to determine whether the reductions actually occurred to the extent expected or if the efficiency measures resulted in a rebound effect. However, rebound risks were clearly present: data from the environmental declarations show that the actual efficiency gains from the first two measures did not fully translate into corresponding and sustained reductions in total consumption. In its B2B coating business, Henkel has to process a fluctuating but increasing proportion of heavier parts. The interviewees pointed out that the increased need for process heat eats up the savings from the efficiency measures. This can be seen as an output effect that is triggered further down the value chain: the rebound effect results from Henkel processing more product mass due to changes by industrial customers. In the case of the conveyor, for example, this means that

although the supports are lighter and save energy compared to the old technology, the products transported are heavier and literally outweigh the improvements. Additionally, the use of high-strength steel in the conveyor means that it can handle heavier products. This could be described as a reutilization effect: with the efficiency measure, Henkel has also increased the performance, enabling changing customer requirements. Finally, the financial efficiency gains (such as reduced expenditure on electricity, process heat and motors) will feed into Henkel's investment budget. This could trigger a re-investment effect, where the accumulated savings finance medium- to long-term investments that in turn trigger resource consumption. In the case of the booth replacement, for example, the reinvestment of previous efficiency gains indirectly led to deteriorating consumption data, despite Henkel's efficiency targets.

4. Findings

In order to determine whether and which rebound effects occurred, we will interpret Henkel's practice against the background of the rebound drivers presented at the beginning.

4.1 Managing rebound risks

As outlined in the introduction, rebound risks increase due to strategic priorities, cognitive and institutional factors, as well as psychological factors. In this context, how can Henkel's approach to efficiency gains be qualified? And how does a sufficiency orientation influence potential rebound?

Strategic priorities

Henkel has a *non-growth, eco-oriented corporate strategy and culture*, prioritizing savings in resource consumption and costs over growth, as described by interviewees and in several reports. A broad concept of "enough" is pursued, and working hours, machinery and production facilities are reduced rather than expanded. With sales stable, profits increase through reduced resource costs and process optimization and are reinvested in the company and its employees while the employer's remuneration is kept stable: "These are also limits to growth: What is contentment? […] [Y]ou can say: That's enough. I would rather go for a walk with my children" (MO 2021).

Improving efficiency does *not aim at expanding production*. Instead, it aims to minimize the use of resources, reduce negative impacts and control costs. Innovative solutions and their effects in terms of efficiency gains are replicated and reinvested throughout the company to reinforce their positive impact. Interviewees confirmed

that efficiency measures do not lead to more growth but rather that "each action has made [them] aware of even more to-dos" (MO 2020).

For the same reason, the *variety of materials and products is reduced* rather than increased, e.g., by standardizing processing through standardized steel grades and higher quality materials, which can support longevity of the products. Standardization and process optimization also make it possible to reduce the number of machines and the size of production halls whose sites are then converted into green areas.

Machines and equipment are used, updated, maintained and repaired for as long as possible. For Henkel, becoming more efficient does not necessarily mean switching to modern machinery – quite the opposite. Henkel uses some machines that are many decades old, and the interviewees stated that they prefer the older ones as they are "much more efficient than the new machines […], they are more stable, maintenance is very easy" (HF 2021).

Annual action plans set *priorities for (replacement) investments*. These are financed through accumulated efficiency gains and follow clear guidelines: they should deliver further resource savings or otherwise enable social and environmental improvements. Solutions are preferably low-tech and low-energy and are often adapted from other applications. For example, spaghetti strainers are used for rainwater filtration, milk filters replace large filter systems in the production water cycle, and the cooling of the production halls is modelled on the ventilation principle of termite mounds. Manual labor is constantly improved but explicitly preserved.

In addition, *potential co-benefits* are identified and incorporated into the planning process to find the measure that will deliver the greatest efficiency gains with the least risk of rebound. For example, a planned modification of the supply air system was combined with heat recovery for the high-power coating systems and an improved transport process for faster cooling of parts, resulting in less extra cooling. Additionally, it presented an improvement for the workplace as parts were less hot when handled by employees.

The furniture unit became *less manufacturing-oriented and more service-oriented:* Henkel's aim is to provide high-quality, durable furniture that could withstand intensive use and adapt to changing physical needs. To support their longevity, products can be refurbished, and components are standardized and replaceable. Commercial and private customers are strongly encouraged to refurbish rather than buy new.

Henkel does not use the term "sufficiency". However, all three principles of "less, better and enough" guide its life cycle management and are strongly reflected in the strategic prioritization within the company, influencing and potentially reducing rebound effects in various sufficiency-related ways.

Cognitive and institutional factors: knowledge, tools, structures

As Henkel's resource consumption data shows, focusing on absolute reductions and non-growth is not only crucial to limit, reduce and avoid possible rebound effects but also reinforces the positive effects of efficiency measures by focusing attention on the necessary knowledge base and structures for learning. Continuous data collection is necessary to reduce or avoid possible rebounds. Henkel attaches great importance to creating this information base. As part of its *energy and material flow management system,* consumption data for products, machines, systems and processes are collected and aggregated on a regular basis.

Major energy consumers are prioritized as a basis for decisions on replacement or investment measures. *Measures are planned in detail* and their success is *closely monitored*. In addition, *employees are systematically involved* in measuring and recording and are strongly encouraged to develop solutions: "It comes from the 'smallest' employee: if there is an idea, it is addressed and […] that's how everything is initiated and that's how solutions are sought" (HF 2021).

All *employees are also trained* on quality and energy management to raise awareness, "so that if an employee walks past a compressed air leak and hears it, they will report it" (MO 2021). This awareness could also be used by employees in their own homes and other surroundings to improve efficiency and energy management.

Learnings are transferred directly and systematically to other use cases. Improvements are automatically checked for their relevance in other areas, "and then they are always transferred in full" (HF 2021). This may involve a new approach to identifying a problem, a better material, a more convivial technology or more like-minded business partners.

Collaboration with research institutions is used to fill knowledge gaps and develop missing tools and assessment methods. Such collaboration includes an "active exchange with scientists on the topics of resources [and] climate change: what is necessary, what [is] to do?" (SR 2018) through research projects and lectures.

Consolidation and institutionalization take place through procurement specifications, such as purchasing criteria and routines, as well as contractually regulated individual responsibility for environmental performance. In procurement, product data sheets are required and, e.g., life cycle consumption data is strongly requested while employees' contracts include environmental guidelines.

Knowledge sharing and an institutional orientation towards absolute reductions and non-growth can therefore help to reduce potential rebound risks.

Psychological factors: moral justification, perceived self-efficacy and diffusion of accountability

Not only the tools and structures but also the culture of the company is geared towards making everyone co-responsible. The company's *non-growth eco-positioning is lived and communicated to employees,* reinforcing that every single action of every em-

ployee counts: "[…] [A]t Henkel it's normal, I tell you, it's already in your head that you're always thinking about efficiency and resources." (HC 2021)

Henkel is very active in disseminating its view of environmental and economic problems and the solutions it has developed. In its *reports and communication*, Henkel emphasizes the urgency of political, corporate and individual action in the face of the climate emergency, the loss of biodiversity or the depletion of resources. Internally, the "Effie Bird", an efficiency mascot, is a tongue-in-cheek but constant reminder in the workplace. Interviewees stated that "this [eco-thinking] is already a principle in the company […] and that it's fun to implement it" (HC 2021). Behavioral changes during or after the measures, which could increase resource consumption, are not considered conceivable – which Susanne Henkel doubles down on: "That doesn't fit in with environmentally compliant behavior" (MO 2020).

Henkel's *management also communicates and appeals strongly to suppliers, customers and corporate networks* in order to strengthen their perception of self-efficacy, (personal) responsibility, moral obligation and economic rationality. This includes informing their customers about better materials or less environmentally damaging processes, such as foregoing chemical pre-treatment that can be replaced by other means.

Given Henkel's non-growth strategic priorities and practices, management systems and corporate culture, it can be argued that the lower than possible efficiency gains are neither an outcome nor a re-utilization or reinvestment effect at the company level. Rather, it supports the assumption that rebound risks lie upstream and downstream in the value chain. The accounts presented show that Henkel not only proactively seeks to avoid rebound effects but also to achieve reinforcement effects, i.e. to increase the impact of its efficiency measures.

4.2 Opportunities and limits of corporate action and impact

The focus on sufficiency and self-restraint means that material efficiency gains are not spent expansively and some rebound risks can be reduced. The company's long-term analysis of environmental data shows that resource consumption is decreasing in both absolute and relative terms, albeit with fluctuations. The financial data, however, show that the financial efficiency gains are also partly eaten up by *rising costs*, in particular due to developments in prices, for example for steel or electricity. This also lowers Henkel's rebound risks: with their raw materials becoming more expensive, monetary savings from efficiency cannot be used to buy more material. Thus, by saving resources in absolute terms, Henkel also "simply become[s] a little more resistant to price increases" (MO 2020), which leads to an even more conscious use of materials and energy. However, there are also limitations to how much the business can influence rebound and several external factors are at play.

In terms of resource savings and efficiency measures, internal efforts are partly counteracted by *deteriorating market standards* for replacement investments by equipment manufacturers or by market trends towards heavier products of B2B customers. In the furniture sector, the idea of high-quality, durable, modular and repairable products has been very successful with customers (B2B, B2C). Services that accompany and replace production account for an increasing share of sales. However, Henkel is too small to actually enforce major changes and performance requirements (or transparency requirements) on suppliers and manufacturers: "[I]t's out of our hands to influence people like that. But, unfortunately that's the way it is: The demand is the market, and […] if only ten per cent of all customers want something, then it's not a priority for the manufacturers" (HF 2021).

The situation is similar with large B2B customers in the surface coating service. As *one supplier among many*, Henkel positions itself as a sustainable, carbon-neutral supplier but can only communicate its own positions and innovations to a limited extent – as in the case of the thinner steel. Despite the many benefits of the material, which Henkel emphasizes, B2B customers are reluctant to make the necessary changes to their products, machines and processes, probably "until the cost pressure really increases dramatically for them" (MO 2020). In this context, both *machine manufacturers and large industrial customers focus on value propositions other than environmental improvements* and show less awareness of resource issues. The main reasons for this are expansionary market trends, distorted factor prices, wrong or missing financial incentives and a lack of awareness among customers and manufacturers alike of the running costs of resource use in machinery.

Also within the company itself, some factors make it difficult to identify and avoid rebound effects or to reinforce the positive effect of an efficiency improvement: even though the company attaches great importance to continuous data collection, this is not always specific and comparable enough to track rebounds. Furthermore, although employees strongly identify with Henkel's sustainability positioning, the commitment of the company depends heavily on the activities of its owner-managers, and it is a constant challenge to keep the "management issue" of resource conservation present as an "employee issue". Therefore, both external and internal factors beyond the sufficiency orientation influence to what extent efficiency measures can be implemented and rebound effects can be avoided.

5. Discussion and practical recommendations

Rebound effects in resource use often stem from an unquestioned and enforced economic growth orientation, as material and financial gains from efficiency measures are typically reinvested without reflection in growth steps at the firm level and in the economy as a whole (Wüst et al. 2023). The economic motivation and narrative

with which increasing resource efficiency is usually pursued creates a gap between the absolute need for and the path to a solution. To narrow this gap, sufficiency is increasingly linked to corporate action and discussed in terms of sufficiency-oriented and self-restraining business practices by companies (Niessen/Bocken 2021; Jungell-Michelsson/Heikkurinen 2022). However, single-company case studies on this topic reveal that there is a lack of clear sufficiency orientation at the organizational level to prevent the rebound effect (Robra et al. 2020). This draws attention to companies as consumers: Do they recognize the notion of "enough" for their resource-consuming activities and develop strategies of (selective) self-restraint to avoid further increases in negative environmental and social impacts? And to what extent can companies that limit their growth and resource consumption through sufficiency avoid rebound effects at the company level?

Companies such as Richard Henkel GmbH demonstrate the potential for avoiding rebound effects and strengthening efficiency measures by limiting corporate growth and promoting sufficiency. This case study underlines the importance of a different approach to efficiency improvement, one in which companies reflect on the environmental impacts of growth decisions and systematically place greater emphasis on resource conservation and the notion of enough with regard to both inputs and outputs. A strategic reprioritization toward sufficiency reduces the risk that efficiency gains will be automatically or intentionally re-spent directly. It helps to ensure that the cost savings from efficiency measures are used in an eco-effective manner. The fundamental strategic decision to view resource efficiency as a contribution to absolute reduction rather than as a growth accelerator can therefore be seen as a prerequisite for successful – low-rebound – resource management. This requires environmental awareness and recognition of environmental problems, so that conflicting goals are not resolved "by default" in favor of economic expectations. It also requires a stronger purpose orientation of entrepreneurial action, a reflection on the social costs of a corporate growth orientation (Mayer 2020) and sustained efforts and environmental values of the business owners (Nesterova 2021).

A rebound avoidance approach also requires that companies give high priority to knowledge building, monitoring and reporting in a way that systematically supports the identification of rebound effects. Key to this would be absolute and long-term consumption targets and data at the company, division and activity levels that go well beyond the usual relative and short-term perspective (Lautermann/Schöpflin 2021). This would provide evidence for monitoring efficiency measures and their effects and for identifying factors affecting data trends. However, management systems and tools in companies are often inadequate (ibid.). Henkel continuously monitors and records data trends with the overall goal of achieving "the greatest possible reduction" in resource consumption and environmental costs. While it has been difficult to calculate rebound effects due to the lack of data specificity, the management's knowledge of all operational processes, resource consumers and potential

(cross) influencing factors can nevertheless enable sound planning and decision-making. Incorporating consumption data requirements into procurement criteria and routines to improve the database can raise resource awareness on all sides and ultimately free up capacity, especially in smaller companies, that would otherwise be tied up in lengthy data research. In addition, cross-departmental teams and dedicated resource scouts can raise awareness throughout the organization and generate valuable knowledge about efficiency potentials and losses, as well as about sufficiency measures.

In this context, employees should be involved in strategic decision-making processes (Beyeler/Jaeger-Erben 2022) and be assured that their own actions make a difference. Henkel is an example of how the employees' identification with the strategic positioning of the company and their participation in efficiency measures can keep awareness high so that individual co-responsibility does not diminish. On the contrary, motivation and opportunities to further reduce resource consumption and environmental impact tend to increase over time. However, there are limits to how much employees feel encouraged and empowered to save resources if policy, decision-making and communication remain a matter of management and company ownership.

Furthermore, companies should be aware of the potential rebound effects of their sufficiency-oriented measures. This effect, which has been demonstrated for individual households, offsets the expected energy and emissions savings from sufficiency measures (Sorrell et al. 2020) and limits their effectiveness. In the case of a firm, too, sufficiency can only be determined by looking at its overall behavior. In this sense, the business sufficiency perspective argues against both growth-oriented efficiency measures and isolated sufficiency-oriented value propositions that are primarily intended to contribute to company growth.

The Henkel case study emphasizes the constraints and external factors influencing corporate decisions: The absolute savings achieved by Henkel's reduction efforts are at risk because the company is dependent on market developments in equipment manufacturing and from industrial customers. While Henkel focuses not only on efficiency and consistency measures but also on sufficiency-driven self-restraint, the ecological parameters of the machines as well as the products of the industrial customers often deteriorate at the same time. Therefore, Henkel's measures to increase efficiency are often measures to avoid deterioration.

As Henkel's market power is too small to influence major manufacturers and customers, the company relies on a general change in awareness and values and a coherent policy framework. A substantial increase in a CO_2 tax, for example, could change the ratio of factor prices in favor of labor and make the excess use of resources more expensive (Zell-Ziegler et al. 2021). Currently, exemptions for large consumers from energy taxes and levies prevent action precisely where the relevance and potential for absolute reductions is greatest. In this context, energy labelling or other in-

formation requirements for machinery and equipment manufacturers would make it easier for small companies to obtain relevant information on consumption data and running costs.

In promoting sufficiency to address the (un)intended consequences of efficiency measures, business-related actors and institutions such as industry associations, standardization bodies, consultants, energy agencies, business networks and others play a crucial role. They can enable companies to identify, recognize and reduce rebound risks through training and education formats for various professional groups. Emphasis should be placed on absolute savings targets and on ensuring that achieved efficiency gains are not primarily translated into further consumption elsewhere, making sufficiency a holistic corporate responsibility. In this context, the (rising) running costs of inefficient machinery and their impact on the amortisation period of investments should also be addressed to highlight the economic rationale. Last but not least, multipliers can support the collection of information and the dissemination of solutions through information platforms, networking, exchange and consulting.

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