German Industry has embraced the Energy Transition

BY JOSEF GOCHERMANN

Abstract

After hesitating until the mid-2010s, German industry has now embraced the energy transition and moved to a driver. The pioneers of change are the major energy companies, followed large parts of industry which have initiated radical changes. Even the energy-intensive industries steel and chemistry are phasing out fossil fuels.

Josef Gochermann is with Osnabrück University of Applied Sciences in Germany and Extraordinaire Professor at Tshwane University of Technology in South Africa and may be reached at j.gochermann@hs-osnabrueck.de. This article is based on recent research and descriptions of the German Energiewende for a book published by Springer Nature

The role of industry in the energy transition

Germany is an industrialized country with internationally active companies, particularly in the automotive, plant and mechanical engineering, chemical and pharmaceutical, steel and manufacturing industries. In the past decades, the formerly nationally positioned energy suppliers have also developed into internationally successful energy concerns. However, the majority of the German economy is dominated by small and medium-sized enterprises with strong, mostly family-owned companies. Nevertheless, the large corporations are structurally formative. The impact of their decisions on the national economy is noticeable. Industrial groups therefore have an important guiding function for the implementation of the energy turnaround and the restructuring of energy systems.

Analyzing the behavior of the industry regarding the German energy transition (Energiewende) one can identify three characteristic phases [1], [2]:

Phase I	Renewable energies tolerated as an add-on (approx. 1990s and 2000s).
Phase II	Perception of the change of the energy system (mid 2010s).
Phase III	Acceptance and implementation of the energy transition (from the end of the2010s).

Industry and the German Energiewende in the past

In a simplified view, the energy transition is equated with the increasing use of renewable energies such as solar, wind or biomass. However, the energy transition is much more than just replacing fossil fuels with renewables. According to Rifkin, it is the change of the energy system part of the 4th industrial revolution, the change of the infrastructure element energy source [3]. Nevertheless, the share of renewable energies in the energy supply is a suitable measure to describe the change of the system. The conscious beginning of the energy transition in Germany can be dated back to 1990, when the Electricity Feed Act created the possibility of feeding electricity from renewable energies into the public grid. From then on, the share of renewables rose continuously.

Initially, renewable energies were regarded only as an environmentally friendly supplement. Industry and politics still assumed that energy demand would increase. Renewables could therefore be used in addition without questioning the existing energy sources and generation processes. Germany's excellently functioning supply system, which is characterized by stability, long-term planning, and predictability, was not affected by renewables.

German Industry continued to adhere to this old energy system until well into the 2010s. In a key issues paper from 2010, the Federation of German Industries (BDI) supported the expansion of renewable energies, but at the same time emphasized that "the construction of new, highly efficient coal-fired power plants ... as a replacement for older power plants" must be possible. In the BDI's view, nuclear energy also makes a significant contribution to achieving the climate targets [4].

In 2012, even after the reactor accident in Fukushima, the former head of the energy company RWE, Jürgen Großmann, affirmed that "German coal-fired power plants are the backbone of German industry - and will remain so" [2, p. 79].

The chemical industry also remained stuck in the old energy system. As late as 2015, the world's largest chemical company, BASF, was still railing against politicians, saying that "abroad there is only pity and ridicule for the German energy turnaround" [5].

For plant manufacturer Siemens, the energy turnaround is "an opportunity for tomorrow's markets," but Siemens CEO Joe Kaeser nevertheless believes in 2014 that "promoting photovoltaics in Germany makes as much sense as growing pineapples in Alaska." [6].

The automotive industry showed the strongest persistence. Until the end of the 2010s, it clung vehemently to combustion engines and consistently blocked the introduction of electro mobility. The German automotive industry held on to its cash cow, the internal combustion engine. This technology is mature and thus guarantees high profits with comparatively little investment in its further development. However, these technologies have mostly also reached their performance limits and there is a risk that they will eventually be overtaken by a more powerful technology [7].

The reasons for vehemently clinging to the previous energy system were a mixture of short-term profit skimming, a lack of will to change, and a dose of incredulity about the upcoming changes.

Awareness of the turning reality

In the early to mid-2010s, more and more industries are realizing that the impending change is real and cannot be stopped. From around 2007/2008, more and more pilot projects were initiated, primarily by regional and municipal energy utilities [2, p. 163 ff.].

Energy consumption became visibly decoupled from economic growth, and the share of renewable energies in gross electricity consumption rose from 6 percent in 2000 to 32 percent in 2015 and even well over 40 percent by the end of the decade [8]. The increasing share of volatile power feed-in affects the system.

The first industrial companies in Germany to react actively to the change were the large energy supply companies, first and foremost RWE, E.ON and EnBW. The increasing share of renewable energies and the decision to phase out nuclear energy had put the energy corporations under economic pressure. The old business models of the previously vertically fully integrated companies began to falter. RWE and E.ON in particular were on the lookout for new business models, new structures and new ways of working.

E.ON, the energy utility, was the first to embrace the massive change and make a radical cut. The company was split into the new E.ON, with its renewables, energy networks and customer solutions businesses, and a new company, later called Uniper, with its conventional generation business, global energy trading, and exploration and production. Many analysts described Uniper as a "bad bank" into which the old energies that were being phased out were bundled. However, renewable hydropower is also part of Uniper. The division was based on a very sensible approach: the old energy world was characterized by stability, a long-term approach and predictability; the new energy world is volatile, small-scale and decentralized. The two systems are governed by different business logics, which formed the basis for the split-up of E.ON.

RWE also restructured the Group and recreated a new division, Innogy SE. However, the Group initially still adhered to full vertical integration, from energy generation to Smart Home household products.

If one places both structural approaches side by side, that of RWE and that of E.ON, one recognizes clear duplications, which were caused by the previous regional demarcation of RWE, E.ON, EnBW and Vattenfall (cf. [2]). Now, in a European, possibly in a global market, these duplications no longer made sense. In March 2018, E.ON acquired RWE's shares in Innogy. As part of a swap of business activities, RWE received all of E.ON's main renewable energy activities and Innogy's renewable energy business, a minority stake of 16.67 percent in the enlarged E.ON, and other assets [9]. In the process, RWE abandoned its fully integrated structure and will focus on power generation in the future. For this purpose, the company's own RWE Renewable Energies GmbH was founded.

This realignment of the two major energy companies was more than just a strategic reorientation. It cements the move away from the old German energy market structure and lays the foundations for a new energy market. This realignment is an essential cornerstone and an accelerator of the German energy turnaround.

Other industry groups followed the example of the energy suppliers. In 2020, Siemens spun off its energy division and founded Siemens Energy AG, which even joined the elite group of German listed companies, the DAX, only 6 months after its IPO. In mid-2020, Siemens CEO Joe Kaeser announced the phase-out of coal [10].

Changes are also becoming apparent in the automotive industry at the end of the decade. German automotive manufacturers are beginning to develop electric vehicles, first tentatively, then more decisively. However, the cause is likely to be less an increase in environmental awareness than the enormous market pressure from China, where a certain proportion of e-mobiles has been mandated in the product portfolio.

The irreversibility of the path became finally clear when the CEO of the oil company BP, Bernard Looney, declares the end of the oil age and announced a realignment of his company [11].

The revived discussions about climate change are accelerating the process, but they are not the cause. The transformation of the energy system is not taking place solely because of climate protection, but is also part of the 4th Industrial Revolution. Industry has largely recognized this.

Industry as a driver of the energy transition?

While the mid-2010s saw hesitation among the industry, a new momentum of change developed at the beginning of the new decade. In 2020, the EU Commission announced that it would further tighten the interim climate targets. Instead of widespread protest from the business community, at least international companies demanded stricter rules. Before the announcement of the new EU climate targets, the heads of more than 150 international companies such as Google, Apple and Deutsche Bank had called for a significant reduction in CO_2 emissions [12]. In a letter, they called on European leaders to reduce CO_2 emissions by at least 55 percent by 2030.

The signatories, who included the heads of U.S. software company Microsoft, Swedish furniture chain IKEA and clothing company H&M, said drastic CO_2 reductions were a way to "prevent the worst consequences of climate change." At the same time, stringent climate targets could enable a "sustainable, competitive economic recovery." It is "central" for businesses to get clarity on the EU's planned path to climate neutrality [12].

In Germany, too, industry is increasingly becoming a driver. A group of 17 industrial companies, including big names in German industry such as the chemical groups BASF, Bayer, Covestro, Lanxess and Wacker, the steel producers Salzgitter and ThyssenKrupp, and the building materials group Heidelberg Cement, together with the think tank Agora, the 2° Foundation and the management consultancy Roland Berger, drew up an appeal to policymakers in Berlin in February 2021: "Climate neutrality 2050: What industry needs

from policymakers now!" [13]. According to the report, industry transformation is based on five pillars:

- Massive expansion of renewable power generation and the power grid.
- Electrification of industrial processes and energy efficiency enhancement.
- Establishment of a European & international climate-neutral hydrogen economy.
- Use of CCU/CCS and negative emissions for unavoidable residual emissions.
- Strengthening the circular economy.

It is important for companies to look at the entire value chain, from upstream (energy, raw materials, infrastructure), to midstream (production), to downstream (sales).

Are these targets too ambitious, especially for energy-intensive industries? At least intensive work is being done to achieve them, as some examples from the steel and chemical industries demonstrate.

On the way to green steel

Seven percent of global CO_2 emissions in 2019 were from steel production, according to the International Energy Agency. The one thyssenkrupp steel mill in Duisburg alone accounts for 2.5 percent of all German CO_2 emissions, much more than, for example, all domestic air traffic in Germany [14].

All major steel producers are working on concepts to decarbonize the steelmaking process or at least significantly reduce CO_2 emissions. Most steel mills operate with a classic blast furnace in which the iron ore is mixed together with the reducing agent coke and other components. Burning the carbon from the coke generates the necessary process heat and plenty of carbon monoxide, resulting in high CO_2 emissions. In order to become climate-neutral by 2050, some industrial companies want to replace coke with hydrogen in steel production. This so-called green steel is to be produced preferably with hydrogen derived from renewable energy sources.

Salzgitter AG has launched the SALCOS® R&D project. Since 2015, researchers and production specialists from the Group have been working with Fraunhofer institutes and other partners on the new technologies and their incorporation into an integrated steel mill [15]. With the two research projects GrInHy and GrInHy2.0, the Group is also working intensively on hydrogen production technologies. The image of the future is "The climate-friendly steel mill".

The traditional German group thyssenkrupp Steel is also working on CO_2 reduction. The aim is to make steel production at thyssenkrupp carbon-neutral by 2050. thyssenkrupp Steel is pursuing an open technology approach and is focusing on two paths: the avoidance of CO_2 through the use of hydrogen (Carbon Direct Avoidance CDA) and the use of CO2 produced (Carbon Capture and Usage CCU) [16]. To ensure the supply of hydrogen, thyssenkrupp Steel is planning a joint project with the energy company STEAG and the electrolysis supplier thyssenkrupp Uhde Chlorine Engineers for the construction of a water electrolysis plant at the STEAG site in Duisburg as well as the supply of green hydrogen and oxygen to the thyssenkrupp steel mill in the neighboring district [17].

ArcelorMittal is also working to reduce its CO_2 emissions. The company wants to use hydrogen for the reduction process and convert its plant in Hamburg. ArcelorMittal is working on a pilot plant in Hamburg that is expected to produce around 100,000 metric tons of sponge iron a year from 2024 onwards [18]. In Hamburg, initial considerations exist for the construction of a large electrolysis plant in the port, which would be supplied with energy from the wind turbines off the coast of Hamburg.

Roadmap Chemistry 2050

The German Chemical Industry Association (VCI) is also venturing a long-term view of the future, which is primarily oriented toward reducing CO_2 emissions. The "Roadmap Chemistry 2050", published in October 2019, describes the path to greenhouse gas neutrality from 2020 to 2050 in three paths, which are to be understood as different levels of ambition [19]:

In the *reference path*, companies continue to produce exclusively with today's technologies. Their investments remain at the current level. The companies are also focusing on more recycling. As a result, CO_2 emissions will be reduced by 27 percent between 2020 and 2050 by optimizing today's plant fleet and purchasing lower-CO_2 electricity.

In the *technology pathway*, heavy investment in new production technologies for basic chemicals such as ammonia and methanol are done. Further progress will be made through improved mechanical and chemical recycling of plastics used as feedstock for the production of basic chemicals. Adding measures to those from the reference pathway, emissions from the chemical sector can be reduced by around 61 percent from 2020 to 2050. The goal of largely greenhouse gas neutrality by 2050 is not achieved in this pathway.

In the *greenhouse gas neutrality path*, all restrictions are dropped; greenhouse gas neutrality is set as a target for the middle of the century. Technologies are introduced as soon as their use results in CO_2 savings, without regard to economic efficiency. From 2035 to 2050, all conventional basic chemical processes will thus be replaced by alternative processes with no CO_2 emissions. The new, electricity-based processes increase the electricity demand of the German chemical industry to 685 TWh per year from the mid-2030s. Companies would have to invest around 68 billion euros more from 2020 to 2050, with most of this again starting in 2040. The conversion of the basic chemistry processes alone entails additional investments of up to 45 billion euros. As a result, almost 100 percent less greenhouse gases can be achieved in 2050.

Industry motivation for change

Industry in Germany is urging politicians to make quick decisions on climate and energy policy. Is the

reason a change of mind or rational calculation? Both dimensions are playing a role. First, industrial companies have recognized that industrial plants that would be built according to the old climate-damaging pattern would be investment ruins. Investments in large-scale technologies are designed to last for several decades. So the right investment decisions for 2040 and 2050 have to be made now and there should be no hesitation.

On the other hand, according to the think tank Agora, there is often a lack of a business model for building sustainable plants. If this dilemma is not resolved, Germany faces the threat of an investment blockade. For this, the industry needs a reliable long-term framework for decarbonization [14]. In addition, more and more industry managers have realized that the costs of using nature will increasingly fall on them and that it is more economical in the long term to invest now.

Beyond this, however, a change of mindset and of attitude has also taken place among many industry representatives. In interviews with top managers of RWE, E.ON and Siemens Energy, one sensed a growing conviction to actively tackle climate change and shape the energy transition [1].

In an interview in January 2020, for example, RWE CEO Rolf Martin Schmitz stated that he personally had learned a lot in the last ten years [20]. According to Schmitz, none of them had thought that climate change would come so quickly and that there would be irreversible developments, self-reinforcing effects. Five years ago, he himself did not believe, he said in a later newspaper interview, that climate change would become apparent so quickly. He had thought the buffering capacity of the atmosphere would be greater [21].

Conclusions

German industry has embraced the transformation of the energy system. Brakemen have become drivers, and in addition to the purely economic considerations, there is also a serious realization among many that the transformation of the energy system must be implemented quickly and decisively. German industry can thus be a pioneer and significantly influence technological and political trends in Europe and worldwide.

References

[1] J. Gochermann, Halbzeit der Energiewende? An der Schwelle in eine neue Energiegesellschaft, Heidelberg: Springer Nature, 2021. DOI 10.1007/978-3-662-63477-6

[2] J. Gochermann, Expedition Energiewende, Wiesbaden: Springer Spektrum, 2016. DOI 10.1007/978-3-658-09852-0.

[3] J. Rifkin, The Zero Marginal Cost Society: The Internet of Things, the Collaborative Commons, and the Eclipse of Capitalism, New York: Palgrave MacMillan, 2014.

[4] BDI, „Eckpunkte des zum geplanten Energiekonzept der Bundesregierung," Bundesverband der Deutschen Industrie e.V., Berlin, 2010.

[5] manager magazin, „Energiewende, BASF-Chef Bock greift Merkel an," 11. Feb. 2014. [Online 29.08.21]. Available: https://www.manager-magazin.de/politik/deutschland/basf-chef-kurt-bock-kritisiert-energiewende-a-952674.html.

[6] W. von Petersdorff, „Siemens-Chef macht Witze über Energiewende," Frankfurter Allgemeine Zeitung, 23. April 2015. [Online 29.08.21] http://www.faz.net/aktuell/wirtschaft/energiepolitik/siemens-chef-macht-witze-ueber-energiewende-13555596.html.

[7] J. Gochermann, Technology Management - Identify, Evaluate and Successfully Implement Technologies, essentials, Wiesbaden: Springer Nature, 2021. DOI 10.1007/978-3-658-28799-3.

[8] German Federal Ministry of Economy and Energy, „Information Portal Renewable Energies, Time Series," März 2020. [Online 25.04.21] https://www.erneuerbare-energien.de/EE/Navigation/DE/Service/Erneuerbare_Energien_in_Zahlen/Zeitreihen/zeitreihen.html.

[9] RWE AG, EON und RWE: Zwei europäische Energieunternehmen fokussieren ihre Aktivitäten, 12. March 2018. [Online] https://www.vdpv-rwe.de/assets/content/HORST/Konzernumbau/E.ON%20und%20RWE:%20Zwei%20europa%CC%88ische%20Energieunternehmen%20fokussieren%20ihre%20Aktivita%CC%88ten.pdf.

[10] J. Dams und G. Hegemann, „Siemens-Chef kündigt Ausstieg aus Kohle-Energie an," Welt, 27. Sep. 2020. [Online 08.03.21] https://www.welt.de/wirtschaft/article216662508/Siemens-Chef-Kaeser-Kohle-Ausstieg-und-China-Abkommen.html?cid=socialmedia.email.sharebutton.

[11] bp p.l.c, „Energy Outlook: 2020 edition," London, 2020.

[12] A.-L. Schlitt, „Internationale Unternehmen fordern deutliche CO2-Minderung," ZEIT ONLINE, 15. Sep 2020. [Online 15.09.20]. Available: https://www.zeit.de/politik/2020-09/eu-klimaziele-co2-ausstoss-minderung-unternehmen-2030.

[13] Agora Energiewende, Stiftung 2°, Roland Berger, „Klimaneutralität 2050: Was die Industrie jetzt von der Politik braucht. Ergebnis eines Dialogs mit Industrieunternehmen," 11. Apr. 2021. [Online] https://static.agora-energiewende.de/fileadmin2/Projekte/2020/2020-09_DE-Call_for_Action_Industry/A-EW_204_Klimaneutralitaet-2050_Was-Industrie-von-Politik-braucht_WEB.pdf.

[14] M. Theurer, „Die Industrie will mehr Umweltschutz," Frankfurter Allgemeine Sonntagszeitung, 21.02.2021, p. 19.

[15] Salzgitter AG, „Salzgitter Low CO2 Steel Making," 2021. [Online 21.02.2021] https://salcos.salzgitter-ag.com/.

[16] thyssenkrupp Steel Europe AG, „Mit Wasserstoff zur klimaneutralen Stahlproduktion. Die klimastrategie von thyssenkrupp Steel zur nachhaltigen Stahlproduktion.," 2021. [Online 21.02.21] https://www.thyssenkrupp-steel.com/de/unternehmen/nachhaltigkeit/klimastrategie/?gclid=Cj0KCQiApsiBBhCKARIsAN8o_4jILtQ2IDWyTdofIjAMkVxzCMmbxNesuG4Vab2FJhCsECN_hFUg3WQaAknXEALw_wcB.

[17] thyssenkrupp AG, „Grüner Wasserstoff für grünen Stahl aus Duisburg: STEAG und thyssenkrupp planen gemeinsames Wasserstoffprojekt," 3. Dec. 2020. [Online 21.02.21] https://www.thyssenkrupp.com/de/newsroom/pressemeldungen/pressedetailseite/gruner-wasserstoff-fur-grunen-stahl-aus-duisburg--steag-und-thyssenkrupp-planen-gemeinsames-wasserstoffprojekt-91318.

[18] Arcelor-Mittal, „Hamburg: Wasserstoff-Projekt mit konkreter Planung," 2021. [Online 21.02.21] https://germany.arcelormittal.com/icc/arcelor/broker.jsp?uMen=9d0f6fbb-a799-5199-f8b4-947d7b2f25d3&uCon=efe407a1-7e2f-4171-5933-6eb4ba5c485d&uTem=aaaaaaaa-aaaa-aaaa-aaaa-000000000011.

[19] FutureCamp Climate GmbH & DECHEMA Gesellschaft für Chemische Technik und Biotechnologie e. V, „Roadmap Chemie 2050. Auf dem Weg zu einer treibhausgasneutralen chemischen Industrie in Deutschland," Verband der Chemischen Industrie e.V. (VCI), Frankfurt a.M., 2019.

[20] R. M. Schmitz, CEO RWE AG, Essen, Interview 17. January 2020.

[21] D. Wetzel, „Ökostrom: RWE-Chef Rolf Martin Schmitz zur Energiwende," WELT online, 21. Dec. 2020. [Online 30.12.20] https://www.welt.de/wirtschaft/article222927938/Oekostrom-RWE-Chef-Rolf-Martin-Schmitz-zur-Energiewende.html.