

RELEVANCE AND POTENTIAL FOR INDUSTRIAL ON-SITE ELECTRICITY GENERATION ON A EUROPEAN SCALE

Patrick Dossow, Forschungsgesellschaft für Energiewirtschaft mbH, +49 89 158121-63, pdossow@ffe.de
Serafin von Roon, Forschungsgesellschaft für Energiewirtschaft mbH, +49 89 158121-0, sroon@ffe.de
Timo Kern, Forschungsgesellschaft für Energiewirtschaft mbH, +49 89 158121-35, tkern@ffe.de
Andrej Guminski, Forschungsgesellschaft für Energiewirtschaft mbH, +49 89 158121-34, aguminski@ffe.de

Overview

The present day situation of electricity generation and utilisation is on the brink of a radical transformation process. Especially with regard to large proportions of renewable energy sources extending all over Europe, a more flexible and adaptive power generating system including high shares of power reserves is inevitable in the near future [1].

In this context, a substantial share of conventional electricity production is due to on-site generation by medium to large scale companies, which appears to be underrepresented in contemporary studies. Such industrial power plants are seldom bound to wholesale energy market conditions and therefore operate fundamentally different than plants of public supply [2]. Not only could these industrial power plants constitute a corner stone to incorporate higher proportions of conventional electricity producers into the market, they also bear the potential for increased flexibility in the electricity sector, which is highly desirable to ensure electricity supply [3].

To fully comprehend the magnitude of industrial on-site generation on a European scale, the paper examines the status quo of on-site electricity generation in the industrial sector for 13 European countries. Distinctive features and country-specific characteristics in terms of magnitude and system structure are elaborated on a broad knowledge base. Special attention is paid to different usages of energy sources and cogenerating power plants (CHP-systems). The hourly rates of power generation of individual industrial power plants are assessed to identify characteristic modes of plant operation and relevant motives for on-site generation in industry. Such considerations give rise to benefits and drawbacks on a national scale. To examine future potentials, possible changes in the framework of flexibility options and market integration are discussed. As a result, the study outlines the relevance of European on-site generation in industry with a focus on future energy system transitions.

Methodology and results in this paper were compiled within the project [eXtremOS](#), supported by the Federal Ministry for Economic Affairs and Energy of Germany (funding id: 03ET4062).

Methods

The method employed to gain a detailed insight on industrial on-site generation in a European context consists of four steps. In general, the analysis level of detail begins on a large European scale and successively reduces its granularity down to the smallest level of individual producers. The procedure is explained in figure 1 in detail.

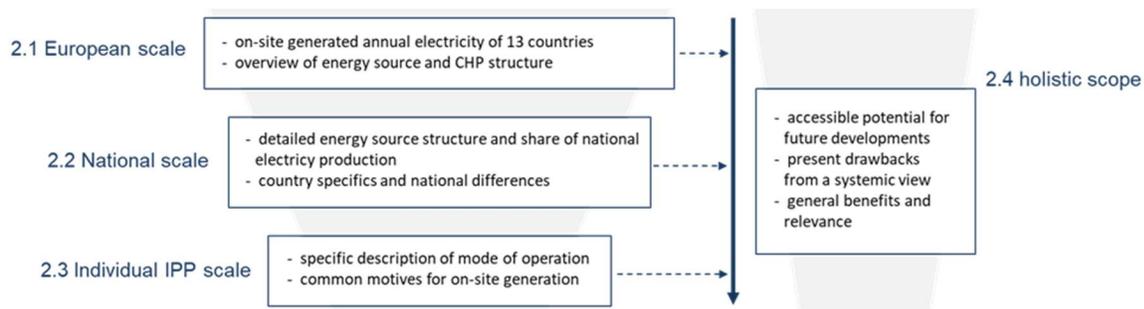


Figure 1: Methodology to assess European on-site generation: Step 1-3 represent a top-down approach, whereas step 4 follows a holistic structure thereby utilizing the findings of the previous three steps.

First, statistical data regarding on-site generation is gathered and processed, where sources such as [4] provide a broad knowledge base for 13 different countries. This step aims on presenting a detailed picture of the status quo.

Second, country-specific characteristics and differences are elaborated. For this step, the data regarding industrial on-site generation is compared with total electricity production data, where statistical abnormalities can be highlighted and the relevance of national on-site generation is assessed. A comparison among the examined countries yields deviations and similarities in terms of operation and usage of industrial power plants.

Third, hourly electricity production data of generators all over Europe is of use to identify industrial power plants. This identification process is conducted by an algorithm, which takes national spot market prices, operating hours and electricity generation costs into account. As a result, concrete modes of operation and motives for on-site generation can be analysed and compared.

Fourth, future potentials of existing industrial on-site generation are evaluated. A list of benefits and drawbacks is developed on a national and European level. A conclusion of the possible development of industrial power plants for flexibility options such as power control and energy supply security is drawn taking each country's individual potential into account.

Results

The paper's results are first presented in the context of the European status quo to display relevance and magnitude of the findings. The high share of CHP-systems for electricity generation in industry and the large proportion of fossil energy sources and natural gas in particular display the fundamentally different structure of on-site generation in comparison to generators of public supply.

On a national level, the study focusses on energy sources, CHP-system usage and share of industrial on-site generation of both general public generation and industrial electricity demand. It is found that the mix of energy sources used for on-site generation varies greatly between the countries as does the CHP-usage. Key reasons for this finding is the availability of resources, the structure and magnitude of the national industrial sector and the national regulations.

In addition to statistical data, power generation curves of real industrial power plants are presented to examine modes of operation. All industrial plants operate with little regard to national spot market prices. Instead, their electricity generation curve resembles the rate of manufacturing for which the plant is built. Identified main drives for on-site generation are autonomy, security of electricity supply and financial advantages. When comparing these motives, no major differences are identified among the countries.

Main benefits of on-site generation are above all the preservation of important companies and the utilisation of waste products for electricity generation. Yet, incentives granted to on-site generating companies are not considered to be just for generators of public supply. Thus, for future developments on-site generators must also invest in renewable energies and adjust to provide flexibility of some kind. Concerning the future potential of on-site generation, governmental regulations are a key mean to lead industrial on-site generation to a sustainable transition.

Conclusions

Industrial on-site generation is a highly relevant and undeniably relevant part of the electricity sector. The study concludes that on average 9 % of national electricity production is due to industrial power plants, which operate regardless of market conditions while relying on fossil fuels to a substantial extent. As these findings hold true for most investigated countries, a high potential to employ these power plants in a system conducive manner is identified. Ideas such as using industrial power plants for power control or integrating them in the national spot markets are evaluated. To be able to transform on-site generation on a European level, a change in regulatory is inevitable. Thus, the paper aims on underlining the importance to approach the topic of industrial on-site electricity generation for future benefits of the energy system.

References

- [1] Genehmigung des Szenariorahmens für die Netzentwicklungsplanung 2019-2030. Bonn: Bundesnetzagentur für Elektrizität, Gas, Telekommunikation, Post und Eisenbahnen (BNetzA), 2018. (German language)
- [2] Von Roon, Serafin; Dossow, Patrick; Kern, Timo and Hinterstocker, Michael: Die Bedeutung der Industriellen Eigenerzeugung bei hohen Anteilen erneuerbarer Energien. München: Forschungsgesellschaft für Energiewirtschaft mbH, 2019. (German language)
- [3] Scheller, Kay: Bericht über die Koordination und Steuerung zur Umsetzung der Energiewende durch Bundesministerium für Wirtschaft und Energie. Bonn: Bundesrechnungshof, 2018. (German language)
- [4] Stromerzeugungsanlagen der Betriebe im Verarbeitenden Gewerbe sowie im Bergbau und in der Gewinnung von Steinen und Erden - Produzierende Gewerbe 2017. Wiesbaden: Statistisches Bundesamt (Destatis), 2017. (German language)