



Assessment of energy efficiency of metals, pulp & paper and commerce sectors – the challenge with indicators

Johanna Kirkinen (johanna.kirkinen@energiavirasto.fi), The Finnish Energy Authority, Finland
Lea Gynther, Motiva Ltd, Finland

EXTENDED ABSTRACT

Energy efficiency is energy input per output (product or service). Many indicators exist, some better than others, to describe the development of energy efficiency by, e.g., the IEA, JRC and the Odyssee-project.

This extended abstract introduces energy efficiency of three industrial sectors: pulp and paper, metals, and commerce. These studies found out what strengths and weaknesses exist when energy efficiency is analysed by indicators and then compared within an industrial subsector, a country, or the EU.

Background

Energy efficiency is often analysed by different indicators. These indicators try to show the development of energy efficiency within an industrial subsector, a country, or the EU. However, sometimes indicators fail to show the concrete development and are misleading due to the suitability of the chosen indicator for the analysis. If the indicators were to indicate the true development, they would need to be carefully chosen to fulfil the task they are meant to do i.e., measure the relation between useful output and energy input during a certain time.

This extended abstract introduces three different analyses of the energy efficiency indicators. The First analysis was about the pulp and paper industry¹, the second study was about the metal industry², and the third was about the commerce sector³. Each of these studies was performed during a year-long project, in close collaboration with the industry. The methodology of the studies encompassed company and researcher interviews and quantitative analysis. The main objectives were to compare energy efficiency between different companies and plants within these sectors and individual plants/sites in Finland to other countries and to find out the factors that have an impact on the comparability and may lead to misinterpretations in simplified comparisons. All the studies used data from the Odyssee database⁴ and additional sources, such as data from different consultancy companies.

Results

Our studies found that the use of energy intensity (energy use per GDP or value added in the industry sector) as an energy efficiency indicator leads to false conclusions, especially for bulk producing energy intensive

¹ Koreneff, G., Suojanen, J. & Huotari, P. 2019. [Energy Efficiency of Finnish Pulp and Paper Sector](#). Research Report VTT-R-01205-19.

² Gynther, L. & Kiuru, T. 2020. [Energy Efficiency of Metals Production Industry in Finland](#). Motiva Ltd., Helsinki, December 2020.

³ Gynther, L. & Heinaro, H. 2021. [Energy Efficiency of the Commerce Sector in Finland](#). Motiva Ltd., Helsinki, November 2021.

⁴ Odyssee database 2022. <https://www.odyssee-mure.eu>

industry sectors such as pulp, paper and steel. Energy efficiency is affected by many factors, e.g., product mix, product quality and climate, factors that should be considered in indicator analysis. Imports also play a role, as energy may be used in one country (e.g. pulp production) and higher value added created in another (e.g. paper production). Making use of a high level aggregate of data is misleading and deeper analysis is needed. However, data confidentiality of company data is a challenge that hinders putting this into practice. Climates also vary widely, making heating and cooling needs quite different and affecting the possibilities for heat recovery. Simple heating degree days corrections are not adequate to fully compensate for the differences, and moreover only few countries report cooling degree days.

Different production routes of electric and oxygen steel are not always taken into consideration when reporting the specific consumption (MWh/tonne) of steel production. Differences in consumption may amount to 500-700%. Inclusion or exclusion of energy consumption data of mill sub-processes as well as statistical boundaries of the industry are very important in enabling comparability. Assessing the energy efficiency of a product from a factory producing multiple different products in the same process is challenging. Also, macroeconomic circumstances are affecting plant utilization.

Statistical boundaries, used to report about sectors such as those caused by industry structure, are a major factor. Outsourced sub-processes are not included in the consumption. Fuels used to produce sold heat are not always subtracted from the energy use of the industrial sub-sector. Given the importance of waste heat recovery in energy policy, this should be made more visible in analyses, reporting and statistics.

For the commerce sector, energy efficiency is analysed by, e.g., energy or electricity consumption per floor area and electricity consumption per employee.

However, the latter indicator does not reflect energy efficiency since there is no fixed relationship between employees and energy or electricity consumption; labour has often been replaced by automation and IT-solutions. Total final energy consumption per floor area is the recommendable indicator in the commerce sector since room space is consuming energy, and by lack of a better alternative. This indicator is also used in the household sector. Value added is not recommendable output by IEA, the market situation may vary and still the same energy consumption remains.

Conclusion & discussions

Country comparisons based on aggregated data often lead to false conclusions. If comparisons are being made, the analysis should be transparent regarding the underlying uncertainties and other relevant factors. System boundaries should be reported in the analyses so that one knows what is being compared. Because country comparisons are made anyway, it is very important to use indicators which really measure energy efficiency.

Within countries where waste heat utilization is common, it is important to take it into account in the analyses – otherwise the results lead to false conclusions. Differences between raw materials used and products made need to be considered. Using recycled raw material affects the energy consumption of the process both in the steel and the paper industry and so does the quality of the product (e.g., different steel and paper types). Therefore, attention is needed for the question if the comparison is made between similar products or not.

Lack of data for better indicators should not be used as an excuse to use inadequate indicators, such as energy per employee in the services sector. In the commerce sector, attention should be paid to not compare different size units with each other, but rather similar size units/companies.

Indicators are at their best especially in the industry when used for monitoring progress within one country, not in country comparisons. Industrial processes can also differ within a country. System boundaries and differences in definitions very often hamper comparability. Operating conditions have an impact too.

More attention should also be paid to multiple benefits (e.g., GHG emissions, use of raw materials, recyclability of the products and waste reduction) to understand the wider sustainability implications in each country, not just energy efficiency.