MinFuture

Increasing security of supply and competitiveness through monitoring of the physical economy in companies and along supply chains

MinFuture Business Brief (D6.4.2)

Summary

Global socio-economic developments increase the complexity of global supply chains and global material flows. Concerns regarding the security of raw material supplies and competitiveness are growing with globally rising raw material demand and prices. Moreover, environmental impacts associated with increased material use affect company activities through environmental policies and public and customer perceptions of sustainability. A robust understanding of the material stocks and flows along supply chains is an important framework condition for developing effective business strategies for addressing these challenges. Overcoming the limitations of monitoring the physical economy is pivotal for securing resource availability, increasing resource efficiency, and communicating good environmental practices and compliance with regulations. The MinFuture project has developed a framework aimed at providing guidance on how to perform a more systematic physical accounting, as well as steps to help implement such a system.

Key recommendations

1. Establish physical accounting linked to financial accounting at site and company levels in order to gain new insights into potentials for improving resource efficiency, reducing costs, and to simplify and clarify reporting.

2. Develop, in cooperation with other businesses and government organisations, a monitoring of the physical economy along the supply chain in order to obtain insights into opportunities and risks for supply chain security, recycling and environment strategies, alternative business models, and procurement practices.

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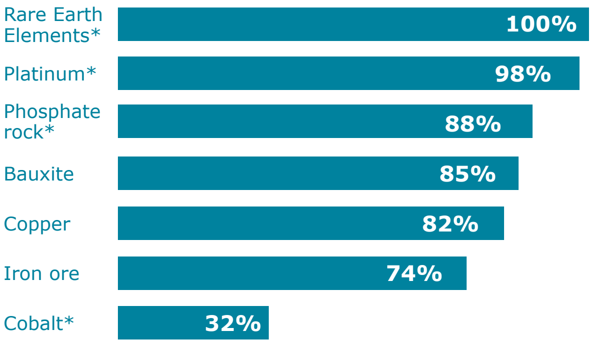
1 What is the need for monitoring raw material stocks and flows?

Raw materials are the backbone of all industrial supply chains. They play a prominent role in global socio-economic development, particularly in countries with emerging industries or industries already in place.

The magnitude and complexity of global material flows has steeply increased in recent decades as consequence of global trends such as population growth, urbanisation, globalisation and technological development (e.g. more complex material combinations in manufacturing). The associated increase in global flows of raw materials and sophistication in supply chains has raised concerns about future raw material availability and management of supply, particularly regarding so-called critical raw materials.

Businesses can benefit from physical accounting at two levels: within the company (e.g., at site level) and at the societal level (e.g., country or global). Monitoring physical material and energy flows (physical accounting) at site and company level is beneficial as it can help optimise industrial processes, which in turn can lead to significant reductions in material and energy requirements, emissions, and associated costs, thus improving business competitiveness and resource efficiency (see Box 1). Furthermore, physical accounting can clarify and simplify mandatory reporting procedures, whether these are for national governments or for corporate reasons (e.g. annual reports and strategy development).

Figure 1: Import reliance of EU member states for selected raw materials in percent [3]



* Critical raw materials (CRM) according to the 2017 list of CRMs for the EU

Box 1: Improving knowledge of material flows helps realise cost savings

An improved knowledge of the material stocks and flows of companies and value chains is crucial for identifying material saving potentials and increasing resource productivity. Considering the ongoing trend of increasing prices of raw materials, advancing in resource productivity is a pivotal factor for improving competitiveness in business. For instance, in Germany's manufacturing sector, material costs constitute a share of 42.9% of total costs, which makes measures targeted at reducing their use particularly relevant [3]. According to a study carried out by VDI Centre for Resource Efficiency (VDI ZRE) [4] for three specific branches of the metal processing industry, improving collection of data about material types and quantities in companies is crucial for analysing individual processes, process chains and operation areas, which in turn allows for achieving company-wide process improvements. Overall, VDI ZRE estimates the material saving potential in these sectors for 2012[1] to be between 2 and 6 % or 763 to 2,364 million Euros [4].

Material Flow Cost Accounting (MFCA) seems to be a relevant tool to improve the collection of data for all inputs and outputs of a company's operations [5]. MFCA combines physical and monetary information about materials and energy flows as well as their related costs, thus helping to improve their eco-efficiency. Through this, it is for instance possible to identify and cut the costs associated with wasted materials, which in individual

1 including but not limited to measures aiming at improving data collection and material flow analysis

companies can make up 40 – 70% of total environmental costs [5]. In 2011, ISO released the ISO 14051 standard for material flow cost accounting, thus fostering the relevance and use of MFCA internationally.

Monitoring the physical economy at the societal level requires cooperation with other companies and government institutions. Information about national, European, or global material stocks and flows can serve as a basis for forecasting material demand, scrap availability, or energy use and greenhouse gas emissions in different regions. This information is relevant for anticipating potential opportunities and risks, and thus for supporting strategic decision-making (see Box 2).

Box 2: Knowledge of material cycles helps companies to develop strategies

The International Aluminium Institute's (IAI) initiative to model the global aluminium flows highlights such potentials: its global aluminium flow model showed that "approximately 75% of all the aluminium ever produced is still in productive use", i.e. bound in in-use stocks [2]. The global aluminium flows model aims at enabling companies to develop their own scenarios for the future use and management of aluminium, in order to support their recycling and energy strategy development. They are frequently updated and openly available online for use under http://www.world-aluminium.org/statistics/massflow/.

Moreover, the case of the global aluminium industry illustrates also an increasing interest of industry associations in developing and using own MFA models to support strategy development.

And finally, physical accounting at company and societal levels contributes to communicating environmental achievements to consumers and policy makers, e.g. in the context of Corporate Social Responsibility (CSR) and compliance with existing regulation.

2 What are challenges for monitoring physical raw material flows in and across companies?

While the relevance of physical accounting at site and company level is increasing, it is implemented to a limited extent only. For one thing, companies on a regular basis report financial data publicly under strict financial accounting rules, whereas physical flows along supply chains are monitored less frequently. Hence, the data used for reporting are commonly expressed in monetary and not in physical terms, which can cause high uncertainties for physical accounting.

Furthermore, companies collect enormous quantities of resource data, inter alia, from real-time process control readings, environmental and cost management data. However, measuring isolated stocks and flows does not allow for analysing and understanding complex flows within a company.

The same problem also holds for the accounting on national or global scales. Information about material cycles are often fragmented, highly uncertain, or lacking entirely. A systemic understanding of material flows in the economy can only be gained through accessing and sharing data between firms and with relevant government institutions. However, due to concerns about confidentiality companies tend to be reluctant to share such data. This limits companies' ability to benefit from an improved understanding of their own role within the economic system for developing forward-looking business models. In addition, the data which companies report to government institutions tend to lack the metadata that are necessary to properly understand the reference points of the measurements. This hinders the development of a mass-balance consistent accounting at national and international levels.

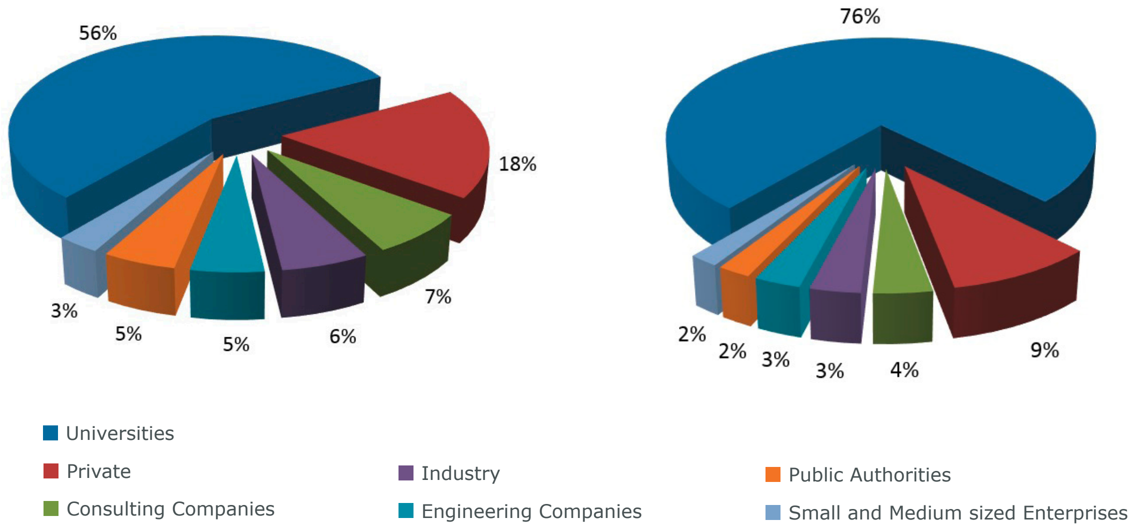
Moreover, there is a lack of appropriate tools and instruments to support the establishment of MFAs on company and societal levels. Such tools should be ideally tailor-made and user-friendly (see Box 3).

Furthermore, there is a need for tools that provide a direct interface to a company's material and financial accounting system.

Box 3: Interest in using software to monitor physical flows is increasing

STAN is a free software for performing MFA, offered by TU Vienna. Increasing numbers of industry stakeholders downloading the STAN software show company interest in MFA models that can be tailored to specific company needs. From 2012 to 2018 industry (see left figure in Figure 2), consulting andengineering companies and SMEs accounted for 21% of downloads, almost doubling compared to the period from 2006 to 2012 (see right figure in Figure 2).

Figure 2: Distribution of STAN software user groups over time



For more information and download of STAN, visit http://www.stan2web.net/

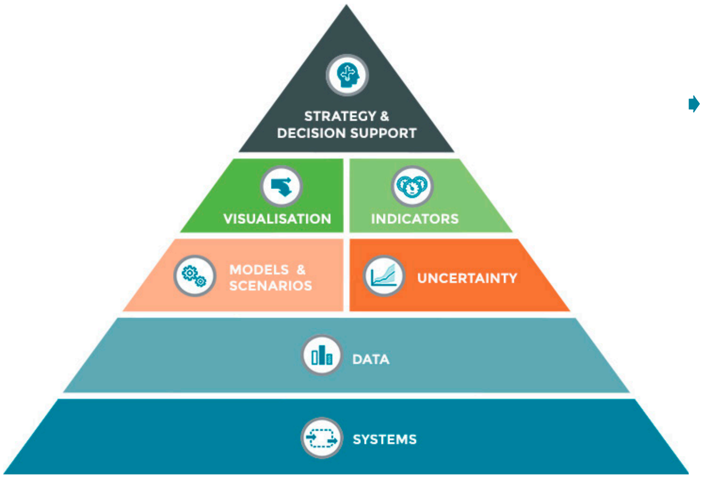
3 What could be done to improve physical monitoring?

MinFuture Framework – A possible improvement for monitoring the physical economy

The systematic monitoring of the physical economy faces several structural and methodological limitations, which hamper its effective use in policy-making. In this context, the EU financed, Horizon 2020 MinFuture project has developed a framework, which intends to help identify and overcome these limitations

The framework roots in the methodology of Material Flow Analysis (MFA). It consists of seven components, organised in a hierarchical structure. Thus, a fundamental principle of the framework is that the robustness of upper levels depends on the robustness of lower level components (see Figure 3):

Figure 3: The MinFuture Framework pyramid [6]



- Data on stocks and flows are only meaningful if the reference points of the measurements in the system are clearly defined and communicated. A well-defined system thus enhances the robustness of the monitoring.
- These are the preconditions for developing **models and scenarios** and for analysing the **uncertainty** associated with the MFA.
- Once the complex system of a material cycle is understood, it is possible to develop appropriate quantitative measures or **indicators**. These serve as a basis for analysing and comparing the performance of different sectors or countries and for determining policy priorities. Elaborating easy-to-understand **visualisations** helps to communicate the outcomes of models and their uncertainty.
- At the top of the pyramid stands the ultimate goal of MFA, namely to **support the decision making** process and to facilitate the development of **strategies** from governments and industries.

Further information:
https://minfuture.eu/framework

4 How could this be achieved?

In order for physical accounting to contribute to improving competitiveness, to simplifying reporting and communicating good environmental practice, we recommend:

- Establishing a physical accounting that links to already existing financial accounting at site and company level. This would facilitate gaining new insights into potentials for improving resource efficiency and reducing costs.
- Using bottom-up, real-time data from process control systems in order to build a resource flow picture for industrial plants. Through this, it is possible to optimise the performance of plants and benchmark processes across similar operations.

In order for companies to improve strategic decision-making through physical accounting along supply chains we recommend:

- Support the development of a common data infrastructure along value chains or among sectors to facilitate collaboration. This can be achieved in cooperation with industry associations or with government institutions that have started to monitor the physical economy.
- The development of a data infrastructure for the monitoring of the physical economy can be greatly improved by reporting the data in a system context, e.g., by providing the metadata necessary to understand the reference points. This should include harmonised technical and monitoring procedures, which ensure that data reporting is done in a system context.

References

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2 Bertram, M., Martchek, K. J. and Rombach, G. (2009). Material Flow Analysis in the Aluminum Industry. Journal of Industrial Ecology, 13, p. 651. doi: 10.1111/j.1530-9290.2009.00158.x

3 Viere, T., Schrack, D. (2016). Accounting for Resource Efficiency. Proceedings of the 20th Conference of the Environmental and Sustainability Management Accounting Network (EMAN), Lüneburg, 2016, p. 259. Lüneburg: EMAN and CSM

4 VDI ZRE (2013). Analyse von Potentialen der Material- und Energieeffizienz in ausgewählten Branchen der der Metall verarbeitenden Industrie

6 Christ, K.L. and Burritt, R.L. (2014). Material flow cost accounting: a review and agenda for future research. Journal of Cleaner Production 108 (2015) 1378-1389

5 MinFuture project (2018) A Framework to improve monitoring of the physical economy. https://minfuture.eu/framework

Further reading:

Fact-Sheet of MinFuture project: https://minfuture.eu/monitoring-physical-economy

A systems approach for the monitoring of the physical economy - MinFuture framework: https://minfuture.eu/systems-approach-monitoring-physical-economy

A roadmap towards monitoring the physical economy: https://minfuture.eu/results

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