Peer Review

CO_2 Reduction Potential in European Waste Management

Study by Prognos AG and CE Delft

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1. Background and objectives

The aim of this research is to estimate the effect of current EU waste legislation and more ambitious targets on the greenhouse gas emissions of the waste management industry by also accounting the burdens and avoidance of the selected waste streams further downstream. The methodology, analysis, and results provide an important and current contribution to research in the field of waste management and climate change mitigation, as well as to ongoing policy discussions on climate change mitigation. The results provide an indicative quantitative orientation for the political discussion on the future development of the waste management industry.

Prognos AG and CE Delft developed a calculation model to estimate the net greenhouse gas emissions, measured in Net-CO_2 equivalents, for different time horizons and potentials for the waste management industry in a life cycle perspective approach. Conventionally greenhouse gas inventories, such as those reported to UNFCCC, account the waste management as a sector "waste" without considering the greenhouse gas burdens and avoidances occurring further downstream in the life cycle of waste, such as through the substitution of fossil fuels and primary raw materials through energy and material recovery of wastes. This study accounts for the linkages from such waste treatment to other sectors and, thereby, more holistically the greenhouse gas emission burdens of the waste management industry.

2. Modelling and estimation

The estimation model developed by Prognos AG and CE Delft consists of three principal methodological steps: estimation of waste volumes by waste stream and treatment route, modelling of EU waste regulation targets on the waste streams' treatment route, estimation of and modelling of the CO_{2eq} factors per waste stream and treatment route for computation with the respective waste volumes.

Waste volumes of waste streams by treatment route

The waste volumes for the selected waste streams are estimated by delimiting, combining, and aggregating waste data of different waste categories primarily taken from official data sources provided by Eurostat. At the European level, for the EU27 member states and United Kingdom, Eurostat provides the most consistent and reliable waste data source available for waste data at country level. Inconsistencies exist at the stage of data collection, provision, and categorisation by the providing member states' agencies. In addition, confidentially clauses introduce data gaps. Availability of waste data statistics at more detailed classification levels varies significantly by country and over time.

The allocation of individual wastes to a waste stream is based on the most detailed classification List of Waste (LoW) available. Current country level data at this level of detail is not adequately available across Europe and provided via Eurostat. These are widely recognised data availability limitations. Deriving the share of LoW waste categories within the European Waste Catalogue (EWC) category, for which data across all Member States of the EU27 and United Kingdom is only sufficiently available, is detailed. The estimation of this share is referred to, but without detailing the number of countries for which the data was available to the researchers upon which the EU average was derived and applied to all remaining countries.

The selection of waste categories that comprise the waste stream is broad including all relevant waste categories for household, commercial and industrial wastes. The drawn upon waste categories exceeds the typically narrow selection focusing on separately collected waste categories. However, no detail on the allocated share of a statistical waste category to a waste stream is provided i.e. the assumed composition of the statistical waste and the respective share allocated to the waste stream, and whether at country level or as an European average. The waste composition of each waste category varies amongst European countries. Secondary data, literature, expert interviews, and project work are mentioned as sources, but not further specified. This information the reader would need to derive from the list of sources cited in the references. Some information may also be proprietary. The impact on the waste streams' waste volumes of such choices remains then unclear. Experience suggests that the separately collected wastes for the selected waste streams will constitute the largest share of the waste streams' volume.

Given the overlap between the material waste streams and the residual waste, the relationship between the two could be made clearer. In contrast to the material waste streams, the residuals are restricted to municipal waste, sorting residues and the sorting and recycling losses of the material waste streams, thereby covering only a portion of the commercial and industrial waste residuals. Within the scope of the study this decision may be reasonable but not explicitly stated.

The limited availability and consistency of waste data is a known challenge, especially at the European level. The study elicits that these issues have been investigated by the study's researchers and addressed in pronounced cases, such as the statistical differences between generation and treatment data for plastic and textile. The resulting uncertainties are made clear and transparent in the methodology and results chapters.

The described methodology and results at the European level is consistent with established approaches, appropriate, and commendable for the application of all available data at the most detailed level of data available for the geographical scope and the broad scope of the waste categories considered for the waste streams. Comparisons in the waste volumes from national studies drawing upon more detailed national statistics available only at the national level are for the geographical scope of this study contingent upon said availability and consistency of data sources. Deviations, thus, cannot be reasonably ruled out from differences in scope, methodology, and data sources.

Applying EU wide the same sorting and recycling losses by waste stream is a strong assumption. Each European country has different collection systems and technical sorting and recycling capacities that affect loss rates. However, the dedicated page portraying a range of losses provides a transparent, justifiable, and reproducible methodological decision.

Given the focus of the study on providing a quantitative orientation of the quantitative effect of the European waste management targets and the poor waste data situation, estimated output-based recycling rates serve as an orientation only. A comparison of the recycling rates against other studies would be desirable, but few, if any, exist for the scope of the selected waste streams for the EU27+UK.

In summary, the modelling of the waste volumes for 10 waste streams by treatment route taking an output-based methodology for the European Union and United Kingdom at country level by drawing upon official statistics and classification systems regulated by European Directives is sound and described at an appropriate level of detail. Given the poor data situation and available resources for the study, the assumptions applied to the derivation of the treatment routes of the wastes is appropriate. The described methodology and results at the European level is commendable for the application of all available data at the most detailed level of data available for the study's geographical scope and scope of the waste categories considered for the waste streams. The underlying data complexity is evident.

Modelling of scenarios by waste stream and treatment route

The modelled scenarios and the underlying assumptions are detailed well and appropriate. The study clearly states that the waste volume is held constant at 2018 level to focus on the effect of the changed treatment routes by the EU legislation and more ambitious targets. Requirements for achieving such targets are not within the scope of the study and are stated as a precondition. The study does not provide evidence or conclusions suggesting that these targets will be achieved. The study makes explicit that these are scenarios given a set of assumptions. Additional transparency is desirable for the link between target and the statistical waste category it applies to. Given that the UK is no longer a Member State, is a significant waste generator and treater, it is open to which extent the application of the EU's target remains applicable to the UK and how its exclusion effects the overall results. A comparison against the historical development would be desirable, but outside the scope of the study. In summary, the modelling of the scenario of the waste regulations is appropriate and transparently described.

Life cycle assessment and modelling of greenhouse gases global warming potential

The greenhouse gas emissions for the waste streams' treatment routes are modelled based on the Ecoinvent database v.3.6 using Simapro LCA software. For the treatment routes of the selected waste streams the greenhouse warming potentials measured in CO_2 equivalents were derived according to life-cycle assessment based upon established databases. In contrast to the IPCC 100-year Global Warming Potential (GWP) perspective, the study uses a 20-year time horizon. The Global Warming Potential is the heat absorbed by any greenhouse gas in the atmosphere equivalent to the heat by the same mass of carbon dioxide (CO_2). A 20-year time horizon was selected, given the recent IPCC report's emphasis on the need to reduce GHG-emissions fast. In addition, sensitivities for a 100-year and a 20-year marginal approach are provided for comparison.

For other gases other than CO_2, the potential depends on the gas and the time frame and expressed as CO_2 equivalent (CO_{2eq}). The choice of the respective CO_2 GWP significantly affects the CO_{2eq} results, but only partly affects their interpretation. Rather, different GWP allow for a more nuanced discussion. A deviation from the standard, however, requires explicit, clear, and transparent statement and justification. This is stated and explained clearly early-on in the methodology and contrasted in the results clearly against the conventional 100-year time horizon, which is included as a sensitivity. The choice for a 20-year time horizon conveys the urgency and generally bleaker present status quo and a more optimistic scenario 2. The results of the 20-year time horizon appear to a non-technical reader, thus, more pessimistic, and thus more urgent to act upon. Consistency with established national 100 year-time horizons is provided by its inclusion as a sensitivity. The results clearly allow for a more nuanced understanding and engagement with the results for an informed discussed, placing priority on the urgency.

The inclusion of different GWP sensitivities (20-year, 100-year, marginal approach) illustrate the very high sensitivity of the GWP factors on the results. The provided detail is considered appropriate. System boundaries, assumptions, and factors are provided at sufficient detail.

A strong assumption is provided by the choice for applying the same CO_{2eq} factors to all countries. The choice for the harmonization of CO_{2eq} factors is justified. Given, however, the high sensitivity associated with the CO_{2eq} factors on the results, an analysis of a sensitivity in this regard, for example, by comparing a European average electricity generation mix versus a national electricity generation mix, is desirable. The application of the results to the national policy context is, therefore, impeded by comparability of the results to specific national context, especially with regards to the energy recovery. This is in part addressed by the inclusion of the marginal approach, which only considers convention energy sources.

In summary, the modelling of the greenhouse gas emission is appropriate and assumptions transparently described. Additional detail would be desirable for a greater applicability to national context but lies outside the scope of this study.

3. Summarizing assessment

The study achieves the aim to estimate the effect of current EU waste legislation and more ambitious targets on the greenhouse gas emissions of the waste management industry by also integrating the burdens and avoidance further downstream. The methodology, analysis and results provide an important and current contribution to research in the field of waste management and climate change mitigation, as well as ongoing policy discussions on climate change mitigation. The results provide a striking quantitative orientation on future development of the waste management industry and substantiates policy discussions.

The study contains the most relevant waste streams, broad selection of the statistical waste categories the waste streams are based upon, and has in result a model with a very high data density and complexity. Methodology and results are well explained. Having the report in a slide-deck format has positive impact on the readability of the study. The contribution to existing research and current policy context is clear and pronounced. The presentation of results allows for a more nuanced understanding and engagement of the results for an informed discussion that places priority on urgency.