Circular economy transition in Denmark

Extended producer responsibility for packaging
As-is assessment, 4 October 2023

DANISH BUSINESS AUTHORITY

Contents

1. Executive Summary

With the Green Deal and associated action plans, such as the Circular Economy Action Plan (CEAP), the EU has set out ambitious goals and targets to achieve the circular transformation of its economy. That new economy promotes a more conscious consumption of sustainable products produced through a regenerative system of resource use. To enable this new economy many stakeholders will undertake a strenuous effort to allow for progress and transformation in different areas.

One key area is the implementation of an Extended Producer Responsibility (EPR) for packaging. By the end of 2024 companies in Denmark (like other EU Member States) will be responsible for the packaging of their products when it becomes waste. Several factors urge Danish companies to get ready for the EPR responsibilities: a higher EU consumer awareness, demand for traceability and broader applied sustainability impact (including human rights, environment, product durability, etc.), the increasing need for accuracy, faster pace and cost-effective ESG reporting across all sectors. These responsibilities entail the collection, handling and reporting of data on their packaging. The data requirements are expected to be rather detailed as the EPR fee will be graded according to the environmental impact of the packaging.

The Directorate General for Structural Reform Support (DG Reform) of the European Commission is funding this study, agreeing to provide technical support to Denmark (through the Danish Business Authority) in the area of standardization and sharing of product data. The general objective of the study is to contribute to institutional, administrative and growth-sustaining structural reforms in Denmark, in line with Article 3 of the TSI Regulation.

The analysis undertaken on EPR on packaging assesses the as-is on the packaging data and how mature various players (especially private enterprises) are to comply with conditions covered by EU legislation that must be implemented at the latest 31 December, 2024. The analysis also examines the drivers and barriers in relation to the digitization of packaging data. It is a complex value chain covering private enterprises, authorities, waste management companies, and Producer Responsibility Organisations (PROs).

From the results of the surveys and interviews undertaken, we found substantial challenges in the maturity level of Danish enterprises on the ability to report the required packaging data, as well as challenges for both the private and public organisations having to handle all the data being reported by enterprises. Although some enterprises collect packaging data, the processes of data collection and data handling tend to involve a lot of manual work and for smaller enterprises their current systems will (in current versions) not be able to handle the new data requirements.

A summary of our high-level conclusions reflects the complexity of the as-is situation:

A. A large amount of manual work is involved in data management by enterprises, PROs, local authorities, and waste management companies. Hardly any of them have automated processes to retrieve or reformat data.
B. Enterprises have difficulty in obtaining data on packaging from their suppliers and it is a manual process without any standard data formats.
C. Legal requirements and customer enquiries are the main drivers for collecting and storing data.
D. There are a number of barriers identified by the enterprises to digitalise their processes, such as resource capacity, costs and the difficulties associated with gathering accurate recycling data.
E. Larger enterprises tend to collect more packaging data and are more digitally mature in their way of collecting and storing data than SMEs, given that they often report on packaging in other countries. They structure their data better, have more financial resources, and are more willing to invest in additional IT systems, tools, and human resources.
F. Enterprises are worried about the upcoming EPR legislation and the lack of finalised requirements and do not believe that their current systems will be able to help them comply with the requirements.
G. The tracking of waste is difficult with the current setup as e.g., the data flow breaks at the border when the waste is handled in other countries.

2. Reading Guide

The report is divided into three overall parts. The first part serves as an introduction that introduces and explains the relevant legislation. Following the introduction, the report presents an analysis of the case study and finally the methodology section can be found in the Appendix.

Throughout the report, a number of abbreviations are used and listed below.

Abbreviation	Explanation
API	Application Programming Interface (i.e. software interface)
DBA	Danish Business Authority (Erhvervsstyrelsen)
DPA	Danish Producer Responsibility (Dansk Producentansvar)
EC	European Commission
EPR	Extended Producer Responsibility
ERP	Enterprise Resource Planning system
ESG	Environment, Social and Governance
KL	Kommunernes Landsforening (Local Government Association)
PRO	Producer Responsibility Organisation

3. Introduction

Like the rest of the EU, Denmark must introduce the extended producer responsibility (EPR) on packaging by the end of 2024. It will make enterprises financially and organisationally responsible for the packaging of their products when it becomes waste. Therefore, from 31 December 2024 onwards, enterprises must organise the collection and treatment of packaging waste and bear reasonable costs in this connection.

This entails that companies that sell or import goods with packaging to the Danish market will have to collect, handle and report data on their packaging. These data requirements will be rather detailed as the EPR fee will be graded according to the environmental impact of the packaging.

Definition of manufacturer and packaging

EPR on packaging is expected to include all enterprises (whether based in Denmark or outside of Denmark) that import or sell goods wrapped or contained in packaging on the Danish market. EPR will apply to all enterprises that fill packaging with a product and sell this product on the Danish market. EPR will also apply to enterprises that import pre-packaged products and sell them on the Danish market. For purposes of the upcoming EPR on packaging in Denmark, packaging will be defined as sales packaging, multipack packaging, and transport packaging (i.e., primary, secondary, and tertiary packaging).
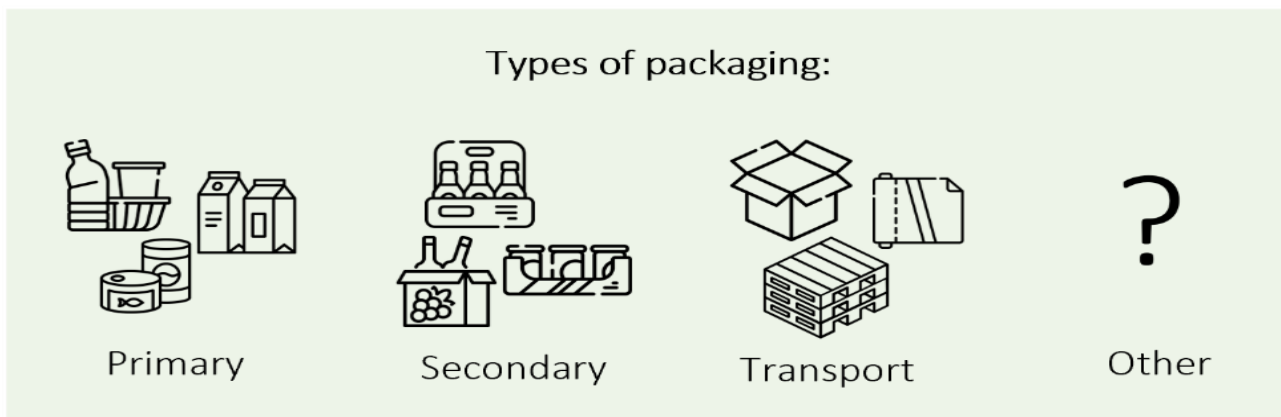
Figure 1. Source: Regulation of the European Parliament and the Council on packaging and packaging waste, amending Regulation (EU) 2019/1020 a

As part of our analysis, we engaged with the Danish public authorities responsible for drawing up the policy and regulatory environment of the upcoming Danish EPR on packaging (the Danish Ministry of Environment – Miljøministeriet), as well as the Danish public authorities that will be responsible for the day-to-day oversight of the upcoming Danish EPR on packaging (the Danish Environmental Protection Agency – Miljøstyrelsen).

Reporting of packaging data

According to the political agreement[1] on EPR on packaging of August 2022, it is expected that in terms of the reporting requirements a minimum threshold of eight tons of packaging a year will be established. Enterprises below this threshold must be registered in the producer register and report annually on their total marketed packaging by weight. Enterprises above the threshold must report packaging data annually by weight, divided into different packaging fractions and, if they are members of a producer responsibility organisation (PRO), also report on environmental criteria that have not yet been determined by the Danish authorities.

Like the current EPR on electronic products, batteries and end-of-life vehicles (ELV), enterprises will be able to handle the EPR-requirements individually or through a collective scheme – a producer responsibility organisation (PRO). A PRO is a private

---

[1] This political agreement was overseen by the Danish Government in 2019-2022 (Frederiksen I Cabinet).

organisation that, for a fee, offers enterprises to carry out some of the administrative and practical tasks associated with producer responsibility, such as reporting data to authorities, entering into agreements with the waste sector, etc. In that case, the individual company will have to report its packaging data to the PRO.

About the report

This report, produced by Deloitte, investigates the "as-is"-situation today regarding the digital maturity in the Danish companies and organisations that will be impacted by the EPR. The report is part of a project called *"Circular economy transition through standardization of product data in automated processes in Denmark"*[2].

The Directorate General for Structural Reform Support (DG REFORM) of the European Commission is funding this study via the Technical Support Instrument, agreeing to provide technical support to Denmark (through the Danish Business Authority) in the area of standardization and sharing of product data. The general objective of the study is to contribute to institutional, administrative and growth-sustaining structural reforms in Denmark, in line with Article 3 of the TSI Regulation.

---

[2] https://reform-support.ec.europa.eu/what-we-do/digital-transition/circular-economy-transition-through-standardization-product-data-automated-processes-denmark_en

4. Analysis

The analysis undertaken on EPR on packaging assesses the as-is, in particular how mature various players (especially enterprises) are to comply with conditions covered by the EU legislation. The analysis also examines the drivers and barriers in relation to the digitization of packaging data. The analysis looks at a complex value chain covering private enterprises, authorities, waste management companies, and Producer Responsibility Organisations (PROs).

The analysis is based on the following data:

- A. Survey responses from 497 enterprises (response rate: 13%).
- B. 44 interviews.
- C. Four observations.
- D. Desktop research.
- E. One Workshop.

4.1 Packaging data collection

Both survey and interview participants were asked about the types of packaging data collected and registered within their company. The answers from the survey show that six out of ten enterprises (58%) collect 'a small share' or above of their packaging data from one or more of the three overall types of packaging or 'other' packaging (see Figure 1).[3] However, four out of ten (42%) enterprises state that they collect 'none' of the types of packaging data[4]. We found that around one third of enterprises collect 'a large share' or 'everything' of data on *Primary/sales* (29%) and/or *Tertiary/transport* (29%) packaging. Around one fifth of enterprises collect 'a large share' or 'everything' of data on *Secondary/multipack* packaging (20%), and one tenth 'a large share' or 'everything' of *Other*[5] (9%) types of packaging.

Proportion of different packaging types being registered in internal data systems

	None	Small share	About half	Large share	Everything
Transport/tertiary packaging	51%	16%	5%	15%	14%
Secondary/multipack packaging	63%	13%	5%	11%	9%
Primary/sales packaging	59%	13%	3%	13%	16%
Other types of packaging	75%	13%	2%	5%	4%
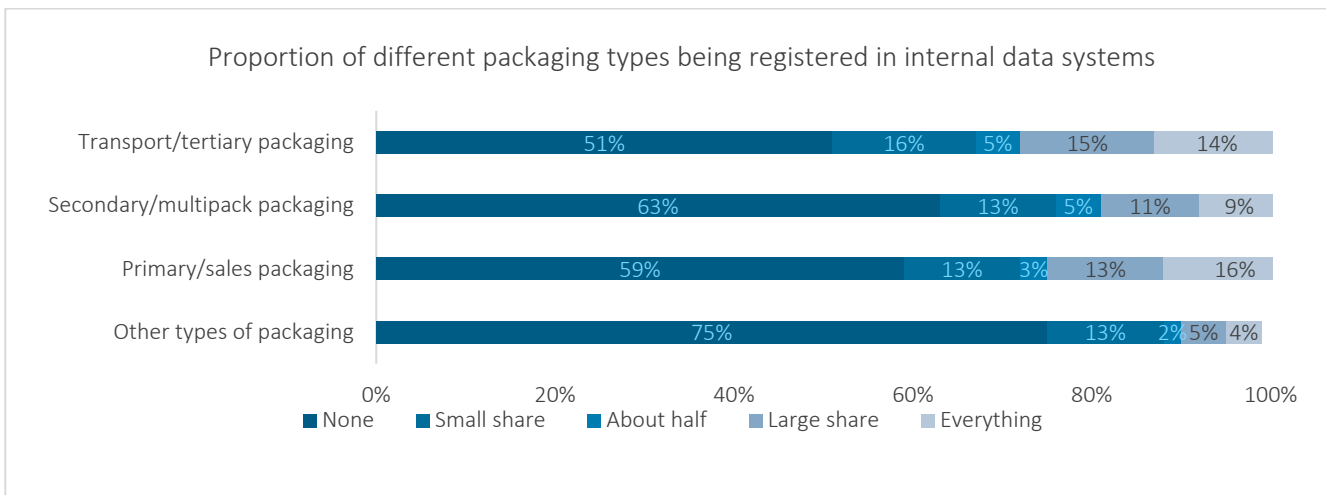
Figure 2. Source: Online survey sent by Deloitte and the Danish Business Authority, January 2023

---

[3] The number of respondents answering to the question 'What proportion of your different types of packaging do you register in your internal data systems?' that they collect either 'a small Share', 'about half', 'a large share' or 'everything' of data on either 'Primary/sales packaging', 'Secondary/multipack packaging', 'Transport/tertiary packaging' and/or 'Other types of packaging'. (N=447)

[4] The number of respondents answering to the question 'What proportion of your different types of packaging do you register in your internal data systems?' that they collected 'none' of their 'Primary/sales packaging', 'Secondary/multipack packaging', 'Transport/tertiary packaging' or 'Other types of packaging'. (N=447)
[5] Not specified by the respondents.

Worth noting about the survey results is that few interviewees stated that there are varying perceptions of packaging definitions between enterprises. According to the interviewees, such perceptions differ much more when dealing with partners across the border. As a food manufacturer explained:

> "You are saying that this is primary packaging but not all customers agree on what is primary and what is secondary packaging. So sometimes it's difficult. It would be nice if there was a standard" *SME*

The varying packaging definitions were also observed during interviews, as several SME interviewees realised their misperception of packaging, thus placing them in the 'above eight tons' despite previously indicating themselves as 'below eight tons' in the survey. Among the Danish SMEs, we find that this is due to a lack of knowledge of EPR, together with varying standards.

4.2 Contents of packaging data

When asked about which part of the packaging data the enterprises register, around half (45%) of all enterprises collect data on the *amount,* one third on the *price* (31%), one fifth on the *weight* (22%) and/or *format* (21%) and/or *volume* (16%).[6] Across all types of content, large enterprises collect slightly more packaging data compared to SMEs.

The data which enterprises were most interested in storing varied based on what they deemed relevant. The prioritisation of various data is generally based on the needs of the business in an effort to save time. Fiscal management, legislation/reporting requirements, and questions from customers were the main drivers for registering specific data. A food manufacturer states:

> "We have a lot of information about the in-house packaging already. But we are only collecting [the data that is needed]. We have basic information on all products and [additional data] if customers or authorities are asking for it" *SME*

Types of packaging data
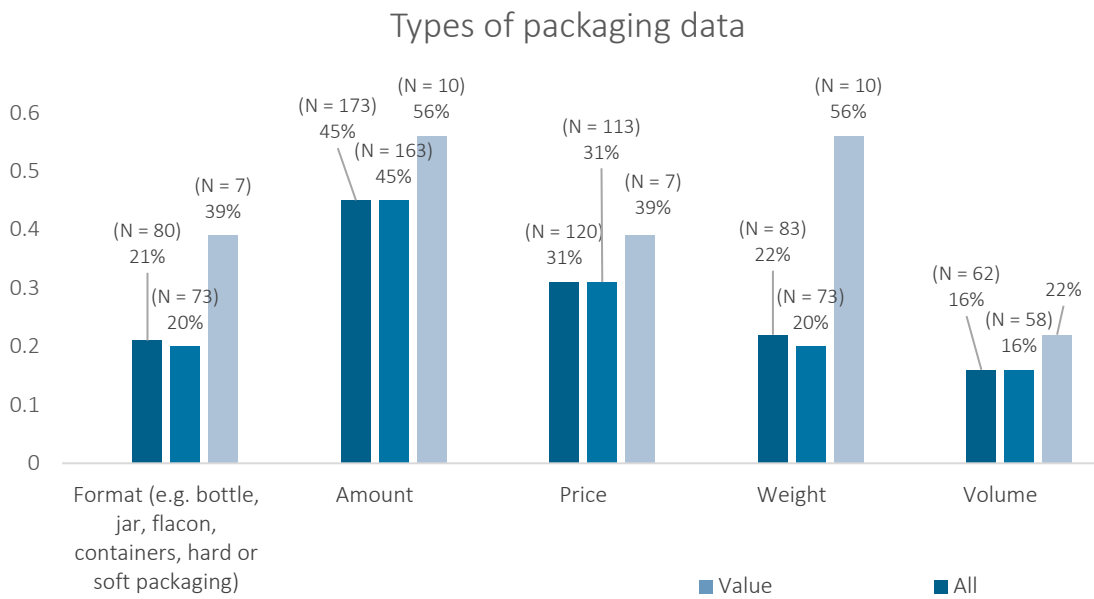
Question: *Which data do you register about your packaging*?
Number of respondents: 383. The question was a multiple question.

Figure 3. *Source: Online* survey sent by Deloitte and the Danish Business Authority, January 2023

When asked about which packaging fractions/material types the enterprises currently register, around half of the enterprises answered *cardboard* (47%) and one third replied *plastic (overall)*[7] (35%). Around one fifth replied *glass* (21%) and/or *paper* (16%),

---

[6] Since the enterprises were able to answer 'yes' to one or more types of data, the percentages do not add up to 100.
[7] Proportion of enterprises that answered 'yes' to collect one of more of the following: Plastic XPS, Plastic PP, Plastic EPS, Plastic PE, Plastic PET, Plastic HDPE, Plastic PS, and Plastic.

and around one tenth replied *metal (overall)*[8] (14%) *and/or tree* (13%). The other types of material are collected by 3% or less of the enterprises in the survey. It is important to note, however, that in the figures below, the denominator for each packaging type include enterprises that do not use the specified packaging types. Therefore, the share of companies collecting data on the packaging they use would most likely be substantially higher than is indicated in these figures.

Packaging fractions/types of material registered by enterprises

Material	Value
Textiles	(N = 5) 1%
Ceramics	(N = 4) 1%
Food and drink cartons	(N = 10) 3%
Tree	(N = 45) 13%
Metal	(N = 33) 14%
Paper	(N = 57) 16%
Glass	(N = 72) 21%
Plastic	(N = 96) 35%
Cardboard	(N = 165) 47%

Question: *Which packaging fractions/types of material does your company currently register?*
Number of respondents: 350. The question was a multiple choice question.

Figure 4. Source: Online survey sent by Deloitte and the Danish Business Authority, January 2023

Registered packaging

Type	Value
Additives	(N = 4) 1%
Adhesives	(N = 6) 2%
Ink	(N = 5) 2%
Coating/varnish	(N = 6) 2%
Closing systems	(N = 7) 2%
Barriers	(N = 6) 2%
Direct print	(N = 8) 3%
Use of chemicals	(N = 10) 3%
Colors	(N = 11) 4%
Composition of different types of materials	(N = 17) 6%
Other components, such as covers, stickers, and lids	(N = 16) 6%
Amount of recycled material	(N = 32) 11%
Hard/soft plastic	(N = 33) 11%
Material	(N = 120) 41%

Question: *What other type of packaging do you register?*
Number of respondents: 290. The question was a multiple choice question.

Figure 5. Source: Online survey sent by Deloitte and the Danish Business Authority, January 2023

---

[8] Proportion of enterprises that answered 'yes' to collect one of more of the following: Metal, Steel or Aluminum

When asked to define the detailed level at which enterprises register packaging data, four out of ten (41%) respondents said that they record *Material.* One out of ten (11%) collects *Hard/soft plastic* and/or *Amount of recycled material.* Six percent of companies collect *Other components such as covers, stickers, and lids* and/or *Composition of different types of materials,* while the rest of the types of packaging are registered by 4% of enterprises or less.

From the qualitative data, we saw a tendency towards the large/medium-sized food manufacturers being the ones with the best overview of their data. These enterprises stated that as food manufacturers, they are required to comply with a series of rules, e.g., packaging and equipment, are subject to regular food and safety inspections, and are already reporting on packaging in other countries. The same pattern is seen in the survey data where the *Food, beverage, and tobacco industries* along with the *Chemical industry*, are the industries collecting most of their packaging data, as shown in Figure 6.
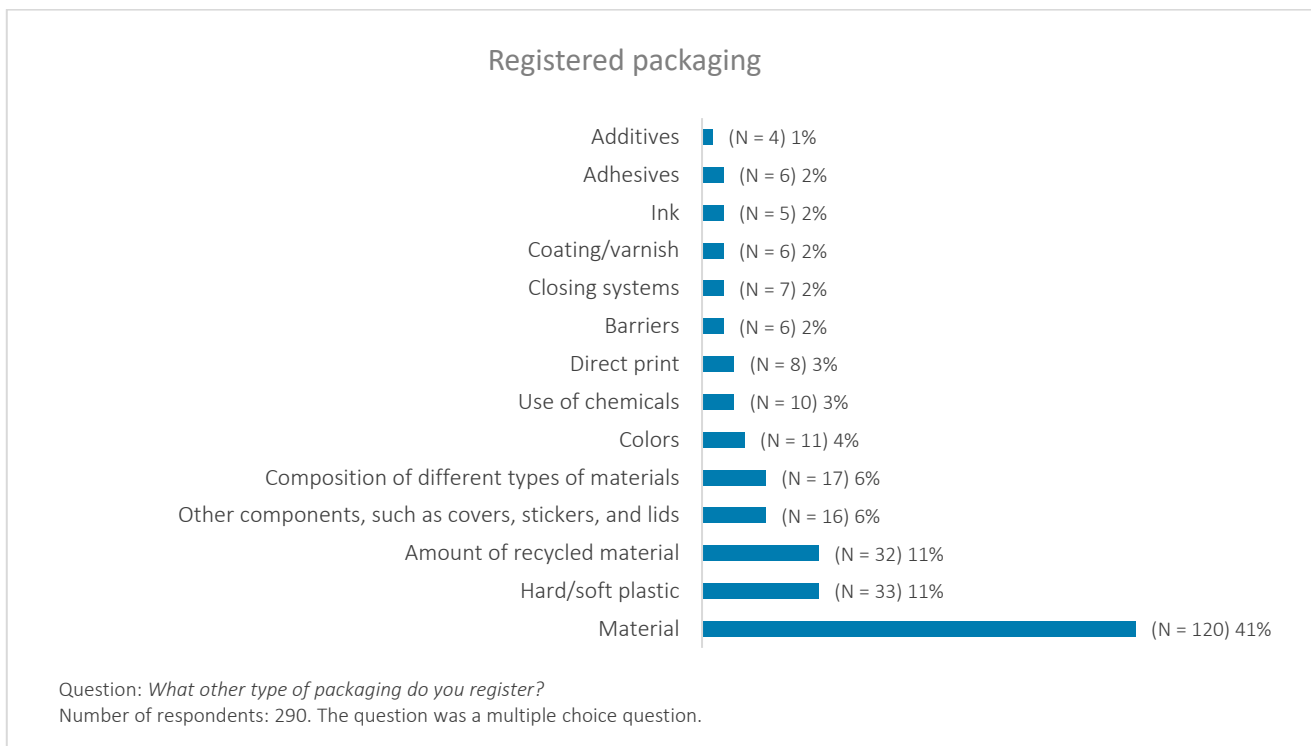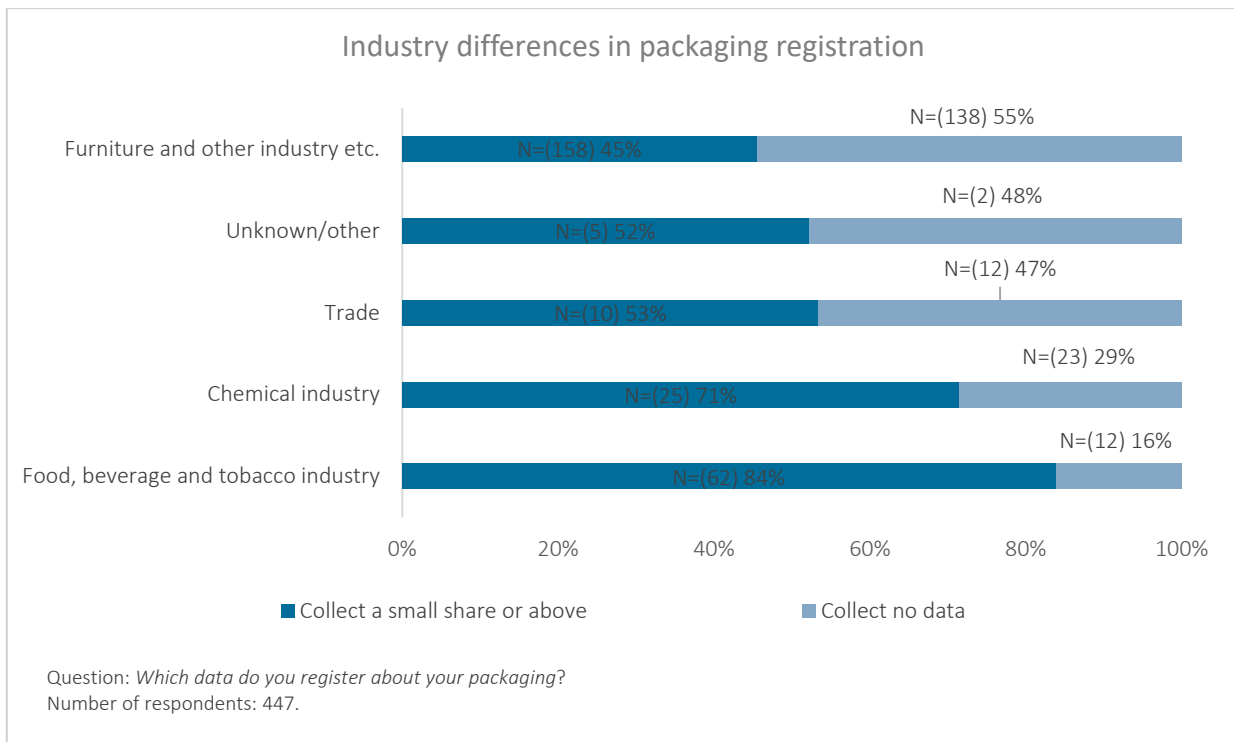

Figure 6. Source: Online survey sent by Deloitte and the Danish Business Authority, January 2023

Green data collection

Several enterprises mention that recyclability of materials is important. However, the enterprises do generally not track the degree of recyclability or material composition but remain at fragment level, i.e., glass, plastic, and cardboard. Only a few enterprises collect and record data on disposal and/or recycling rates. From the survey, we found that one tenth of enterprises collect '*recycling rates for used packaging based on data from waste treatment plants*' while between 8 and 10% of enterprises collect data either on *recycling rates for used packaging based on estimates* or *data sources* (Figure 7).

Several SMEs stated they believed sustainability played a role when choosing their suppliers. A few interviewees mentioned asking about the composition of the material. Still, the interviewees stated that they do not register or store this data. Several SMEs mentioned having conducted exercises to optimise packaging and make it more sustainable such as changing the thickness of the material, encouraging reuse, or using packaging optimisation robots.
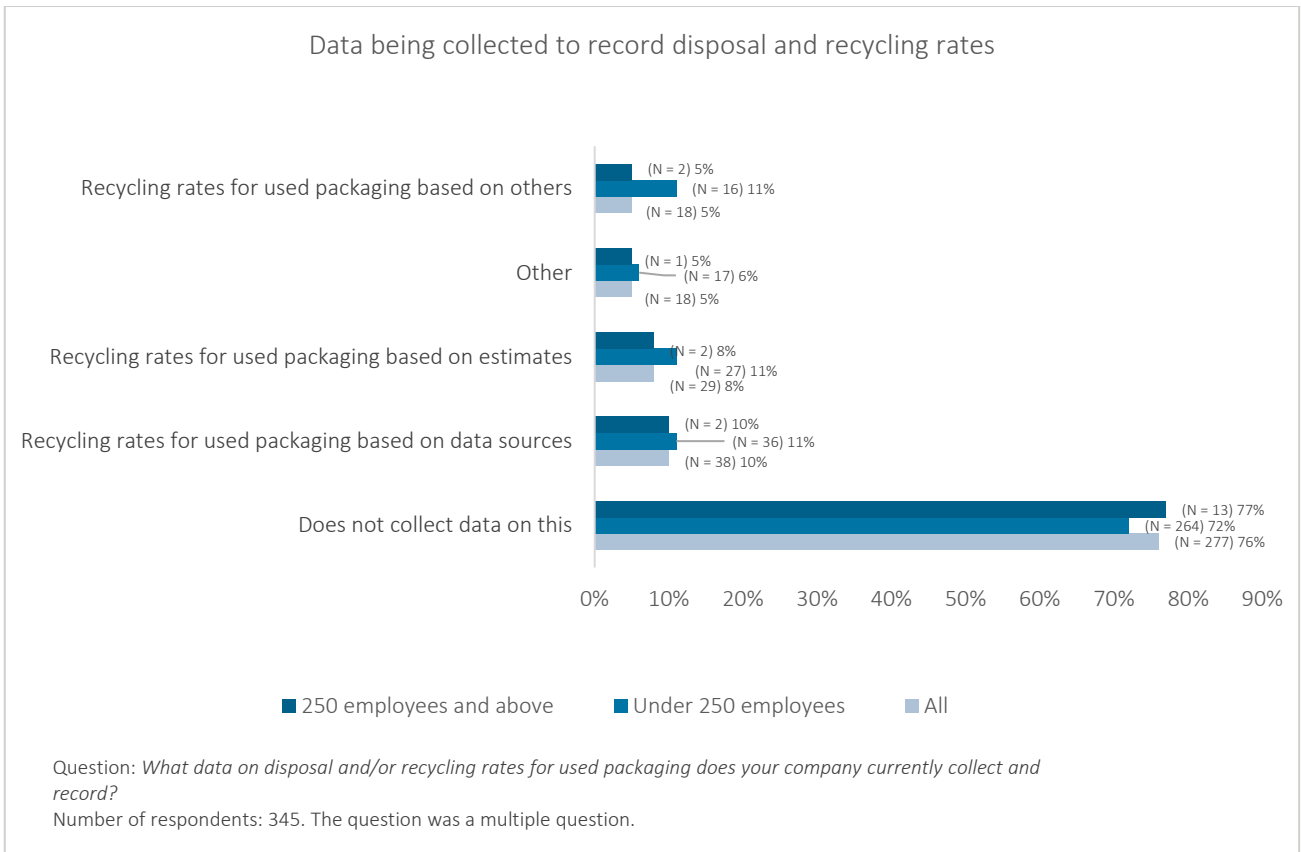
Figure 7. Source: Online survey sent by Deloitte and the Danish Business Authority, January 2023

4.3 Data handling

Most interviewees (regardless of company size) stated that they have no structured processes for collecting and storing their packaging data. When asked which systems/software the interviewed enterprises use to register and store data, the enterprises mentioned email software, Excel, ERP systems, accounting software, and cloud solutions such as Dropbox, Google Drive, and SharePoint. Most interviewees stated that they store packaging data on product sheets or invoices in their email inboxes. Among the interviewees, the most commonly used software for structurally storing packaging data was Excel, or an accounting system, which detailed the financial data. It corresponds with the survey data showing that within the enterprises that register packaging data, the majority use Excel or other spreadsheet systems (21%), while 15% of enterprises use ERP systems. Other data-collection systems are used by 3% of enterprises or less.
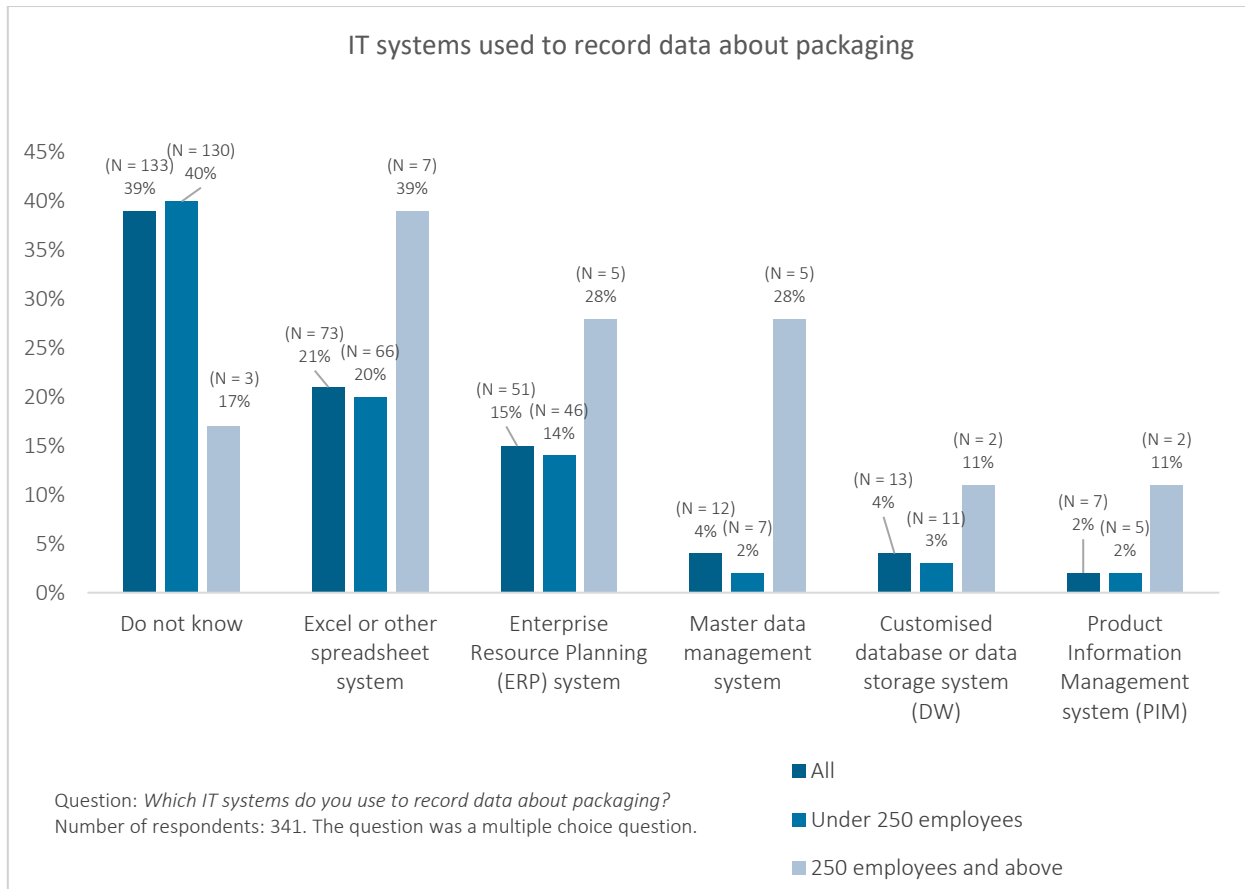
Figure 8. Source: Online survey sent by Deloitte and the Danish Business Authority, January 2023
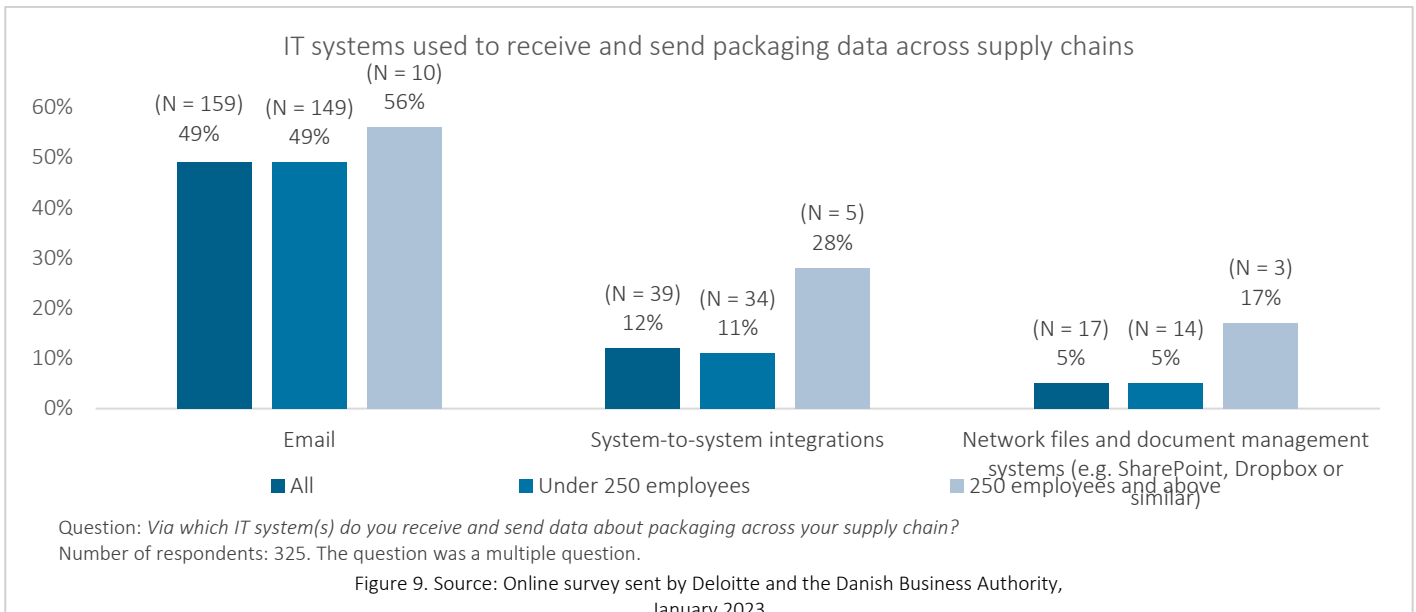
The general picture is that data handling is more manual than automatic.[9] Enterprises structuring their data would manually handle packaging data and enter it into their preferred system or software. A handful of interviewees mentioned that they were able to register packaging data in their ERP system but remarked that the enterprises did not do so, as it created no value. Through the interviews, we found that large enterprises often store packaging data in several departments, such as purchasing, finance, and logistics/warehousing. The large enterprises conducting business in several markets remarked that they handle their packaging data locally, mainly due to differences in legislation and customer requests.

However, these interviewees further mentioned that a central database within the enterprise would facilitate better data management and provide a better overview of data, as the type of packaging used did not differ much between countries. A central database would eventually become the 'single source of truth' of packaging data within a large enterprise. It could be a packaging database working across geographies, rather than the current setup, where enterprises (even large enterprises) operate databases/systems that are tailored to each specific country/market they are operating in, and these databases/systems do not always allow for a holistic overview of packaging across all the markets in which the enterprise is active. A central database would be operated by, and would only be accessible to, the enterprise in question. Moreover, the database might have a functionality for suppliers to input data to the database, but control and management of the database would remain with the enterprise in question.

---

[9] Enterprises generally rely upon their employees to enter and extract packaging data from their systems. The collection of packaging data from suppliers is often done manually (e.g., by emailing or calling suppliers), with the data then emailed to enterprises by suppliers (in PDF format such as invoices etc., or in Excel format (datasets)).When enterprises using packaging for their products are asked by their customers to provide them with information regarding this packaging, the information is often obtained by employees through manual processes (e.g., manual calculations using invoices, manual searches through email exchanges, manual searches through Excel datasets, etc.), and is often, in turn, shared with their customers via email (Excel or PDF format) or phone.

4.4 Data sharing

Several interviewees noted that they do not share any data with their suppliers. Still, several interviewees, especially the SMEs, believed they could obtain the data and estimated the process would take around one week if their suppliers had the data. Nevertheless, most of these SMEs also said they had never conducted this exercise. In general, if the enterprise collected data, it was manually obtained via email exchange in written text or PDF files. Few interviewees mentioned downloading data from the supplier's website. Specifically, the large food manufacturers noted sending out files, having portals in which their suppliers could upload or enter the data, or obtaining data via APIs. When asked in the survey, which IT systems the enterprises use to send data about packaging across the supply chain, 49% of enterprises answered Email, 12% System-to-system integrations, and 5% Network files and document management systems.

Question: *Via which IT system(s) do you receive and send data about packaging across your supply chain?*
Number of respondents: 325. The question was a multiple question.
Figure 9. Source: Online survey sent by Deloitte and the Danish Business Authority, January 2023

A few enterprises had built their own systems for handling or extracting data. These systems consist of digital tools and databases, as well as a clear process map for employees to know how to collect, manage, and process relevant data. For example, one manufacturer we spoke with had developed an electronic tool – which included background calculations/models – that allowed the enterprise to accurately calculate the weight and type of packaging material that it consumed/used to wrap its products in. When combined with a clear data flow process map and the proper training of relevant staff (at HQ in Denmark, in regional offices/regional production sites, and their corporate shared service centre in Eastern Europe), this allowed for an efficient, effective, and accurate system for handling packaging data across their supply chain. While the data on systems is limited to three interviewees, our data suggests that the common factor between those who develop their own systems for handling packaging data is an employee who takes it upon themselves to drive the process and build the system. As one enterprise stated:

"I think the driver for building our own systems was based on some good people who had the skills. They could think ahead of time." **Large enterprise**

Data sharing - enterprises and public authorities

The interviewed enterprises mentioned that they reported to public authorities with different frequencies - from monthly reporting to random checks. Some interviewees reported to public authorities on packaging in other countries, and those that reported to e.g. German authorities reported monthly. The reporting is done by logging into a web portal and entering the number of units and weight under the selected fraction category. The entries were based on units sold and the packaging weight of the selected fraction multiplied by units sold. Some interviewees mentioned issues in obtaining data meant that their reporting was based on estimated guesses. An enterprise describes it like this:

"We are making guesses on the packaging we are placing on the market to comply with German reporting requirements. That is the only option [if we have to report our numbers]" **SME**
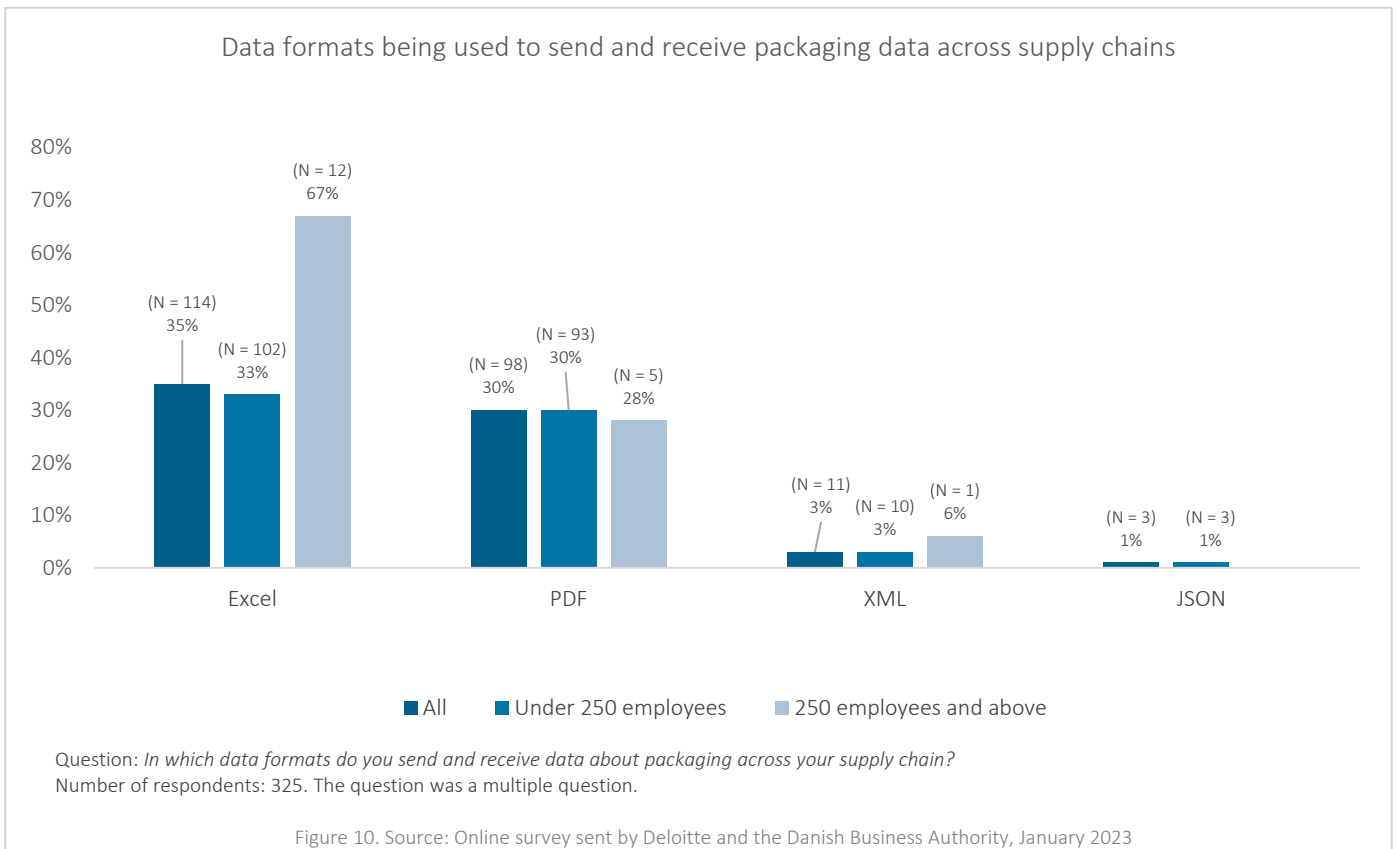
Through our qualitative data, we found that the more enquiries from public authorities and customers an enterprise receives, the better the overview of its packaging data. An interviewee from a Danish PRO also stated that he saw a correlation between frequent reporting and better data management:

"Customers reporting on a monthly basis normally have [the data] under control. As soon as you go down [in reporting frequency, the control starts to loosen]. If you have to do one thing a year, you keep forgetting, and you will have to remind yourself. That is the kind of barrier we are seeing with these customers" **PRO**

4.5 Data formats

Interviewees sharing data with their suppliers stated that there is no standard data format when exchanging data and mentioned that the lack of standardised data equated to the additional manual work. The data formats mentioned included CSV, XML, PDF, and TXT, but there was often no standard when exchanging data with suppliers or customers among the interviewed enterprises. The survey data suggests that the most frequently used data formats are Excel and PDF, with around 30% of respondents marking they exchange data in these formats.

The graph below (Figure 10) shows a general lack of digital maturity amongst the enterprises that responded to the survey, with the majority of enterprises indicating that they were using simpler data formats such as *PDF* (30%) and/or *Excel* (35%), with only a minority of enterprises indicating that they were using more complex data formats such as *CSV, XML*, and *JSON* (3% or less).

Data formats being used to send and receive packaging data across supply chains

Question: *In which data formats do you send and receive data about packaging across your supply chain?*
Number of respondents: 325. The question was a multiple question.

Figure 10. Source: Online survey sent by Deloitte and the Danish Business Authority, January 2023

In general, enterprises would receive data in the supplier's chosen standard data format and manually convert it to fit their preferred system or software. An enterprise voiced: "If they have to deliver something to us, we would probably have to change the data format because there's no structure in this area" **Large enterprise.**

Few interviewees stated they would request for the data to be delivered in a specific format but would still have to do manual work to handle the received data:

> *"We are standardising as much as possible when sharing data with our suppliers. We have set up this spreadsheet; it is a dropdown menu, and we are entering a percentage with recycled content and things like that, but they are still leaving comments out, so it doesn't fit our needs"* **Large enterprise**

We further asked the enterprises which classification codes they use to register and classify their packaging material. Most enterprises either do not use any classification standards (69%) or answered 'do not know' to the question (27%). Four percent of the enterprises use customs codes (HS + TARIC), while other product code standards shown in Figure 11 are used by 2% of the enterprises or less. It suggests that enterprises do not use product code standards to organise their packaging data internally.

Classification standard(s) used to register and classify packaging material

(N= 242) 69% — We do not use a classification standard
(N = 93) 27% — Do not know
(N = 15) 4% — Customs codes (HS + TARIC)
(N = 7) 2% — EAK codes
(N = 5) 1% — Other
(N = 2) 1% — UNSPSC codes

Question: *Which classification standard(s) does your company use to register and classify your packaging material?*
Number of respondents: 364. The question was a multiple choice question.

Figure 11. Source: Online survey sent by Deloitte and the Danish Business Authority, January 2023

4.6 Drivers for collecting and sharing data

When asked what the enterprises use their packaging data for, interviewees mentioned *financial* and/or *sustainability reporting* and *sustainability and/or sales and marketing strategy*. Some large enterprises also mentioned using the data to set specific sustainability KPIs. An enterprise described how its strategy was linked to customers' interest in sustainability:

> *"Our strategy is very linked to what our customers want in terms of recyclable materials and recycled content (...) Our reasoning behind having a sustainable team here on Danish ground is because it is something that our customers are very interested in"* **Large enterprise**

The enterprises stated that customers and legislation are the main drivers to increase their focus on packaging data, with the specific data points collected generally relating to reporting requirements and consumer enquiries. Another enterprise described how external pressure from customers affected the enterprise's prioritisation toward sustainability:

> "[External] pressure [from customers] was also one of the reasons that we thought, "OK, let us put some work into doing something about this. We set up the strategy, launched a partnership with the WWF and set targets. But then for some reason, the pressure or the awareness from our customers dropped, and we did not prioritise it any longer. On paper [sustainability] is one of the most important things for them (...), but many things are when you ask them and then it this whole other situation when they have to make the purchase decision" **Large enterprise**

4.7 Barriers to collecting and sharing data

Attitudes related to packaging data and its value to support business functions were found to be a barrier to collecting and storing data. Many enterprises said they saw no value in collecting and registering data, for example, as they were not required to report on packaging, or their customers were not enquiring about it.

When asked about the benefits of EPR on the environment, numerous SMEs mentioned that sustainability was already a part of their business core and that they were a small player with limited influence on the market. Many of these SMEs further mentioned already having conducted exercises to optimise packaging, such as changing the thickness of the material, reusing and encouraging customers to reuse packaging, or using packaging optimisation robots within the company. Similarly, most of these SMEs believed that sustainability influenced their supplier choice. These interviewees stated that they would not begin registering the data unless required by legislation and exclusively saw the registration and reporting of packaging data as an administrative burden with no or limited benefits for them or the environment, thus pulling them away from essential tasks:

> "The [SMEs] are already conforming with the legislation put forth, and many of them are also pushing sustainability agendas on their own on a small scale....we have all these SMEs in Denmark that are thinking sustainable, that are acting sustainable, but they don't have the time to sit down and spend hours on reporting in different management schemes.... They are busy selling their products" **Business association**

SMEs are particularly struggling to keep track of the varying regulations and requirements across the EU. The lack of uniform legislation has made it difficult for these firms to embrace legal requirements within their business strategy and transform these into a competitive advantage. The lack of strategic perspective on, for example, EPR meant that requirements were seen as a hindrance to the business instead of an opportunity:

Additionally, another interviewee stated how the perception of an industry collided with the sustainability agenda, as the packaging was related to the product value. The interviewee explained that even if their business were to collect data and set targets towards more sustainable packaging, they would face extreme difficulties in influencing producers to change their packaging:

> "The implementation of the previous directives across the European Union has been... relatively lacklustre (...) Many of our members, [with] the implementation of the regulation [being] chaotic across borders, they have sort of dealt with requirements on an ad hoc basis. So, whenever a company has been met with a requirement, they have tried to follow these requirements to the best of their ability" **Business association**

> "In our industry, there is still a perception that the better the wine, the heavier the bottle, and many manufacturers still believe this" **SME.**

Obtaining data from suppliers

Another barrier to incentivising the digitalisation of product data was obtaining data from suppliers. Some interviewees mentioned experiencing an unwillingness from their suppliers to share the data due to, for example, the supplier not having the data or labelling the data as a competitive advantage:

> *"We used to be able to get the data from our old UK supplier but now we have a Dutch one. I tried to get the data from the Dutch supplier, but he said they don't do that, so we don't have to either. But the Danish Veterinary and Food Administration has asked me before with the UK company, and there they did check [the packaging] – and [our supplier] is actually one of the biggest packaging manufacturers in the Netherlands"* **SME**

Enterprises further described that the complexity of obtaining the data increases with each additional link in the supply chain. It may be due to their immediate supplier also lacking the data or the data being segmented throughout different links on the supply chain:

> *"The problem is when we buy, for example, Apple; it's not from Apple; it's from a distributor. They don't have Apple data either. It could be in several hands. This data, I don't think they have it, but if they do, it does not end up with us. That's a huge problem with this packaging. (...) I don't know how we should be able to make [the manufacturer] give us the information. That is not a possibility. If there was some kind of law [forcing] the actual producer to provide it to every supplier in the chain (..) [in a] standard [data] format. That could be a solution, and that would help everything"* **SME**

Enterprises further expressed incurring additional issues in trying to obtain data from suppliers when dealing with non-EU partners:

Several interviewees further expressed concerns about their non-EU suppliers not having to comply with the same legislation as them. The interviewees feared that their suppliers lacked legal incentive to register and share packaging data with their customers, leaving enterprises unable to obtain packaging data. Difficulties in obtaining the data from suppliers further made it significantly more difficult for large businesses to set sustainability targets and commitments regarding packaging.

> *"We get articles from Asia which we import directly. So here we are going to have to spend a lot of time figuring out the specific packaging. We have several countries we can't get things from"* **Large enterprise**

Lack of internal and external IT systems

It is a barrier for enterprises having to digitalise the processes because they generally find it challenging finding the time and the resources to comply with regulations and therefore they do not know (or have the capacity to find out) what and how to digitalise. The enterprises must prioritise their needs and necessity to create a profit, and so several enterprises have lacked the incentive to track packaging data.

Especially the SMEs felt challenged by the level of investment needed to create steady data streams and overviews. These interviewees frequently expressed concerns about having to invest in additional tools and resources to comply with EPR, as it would lower their profits, and therefore showed reluctance to do so:

> *"The level of innovation to find solutions is actually an important key to solving the big problems. And if you have a small startup company, you don't have the resources and don't have the capacity to develop or use different measurements and tools."* **Business association**

Several enterprises stated that, due to the company's limited resources, data management would become an additional task for existing employees. For many SMEs, this task would, therefore, fall on the owner outside business hours. The SMEs did not expect to change processes or IT systems despite not hearing about EPR or knowing the specific reporting requirements. All SMEs believed that the cost of setting up steady data flows via APIs outweighed the benefits and stated that they would not make such changes to their systems. SMEs with limited knowledge would find this too complicated or too much of an additional burden, whereas better informed SMEs or SMEs with more experience on the topic would in fact find better IT systems and better data useful for their business.

The experience of having insufficient IT systems to comply with reporting requirements is observed across a broad section of the survey respondents. When asked *'To what extent do you think that your current IT systems work for the collection, storage, and reporting of packaging data to meet the expected future legal requirements of extended producer responsibility on packaging?'*, around four out of 10 enterprises replied *'To a low degree' or 'very low degree'* (37%). Together, 30% of enterprises answered, *'To a low degree'* or *'Medium degree'* and 15% chose *'Greatly'* or *'To a great extent'*. Around one third (29%) of the enterprises replied *'Do not know'*.

The extent to which current IT systems work for collection, storage and reporting of packaging data to meet future legal requirements and producer responsibility for packaging

(N = 88) 29% — Do not know
(N = 78) 25% — To a very low degree
(N = 55) 18% — To a medium degree
(N = 40) 13% — Greatly
(N = 37) 12% — To a low degree
(N = 10) 3% — To a great extent

Question: *To what extent do you think that your current IT systems work for the collection, storage, and reporting of packaging data to meet the expected future legal requirements of extended producer responsibility on packaging?*
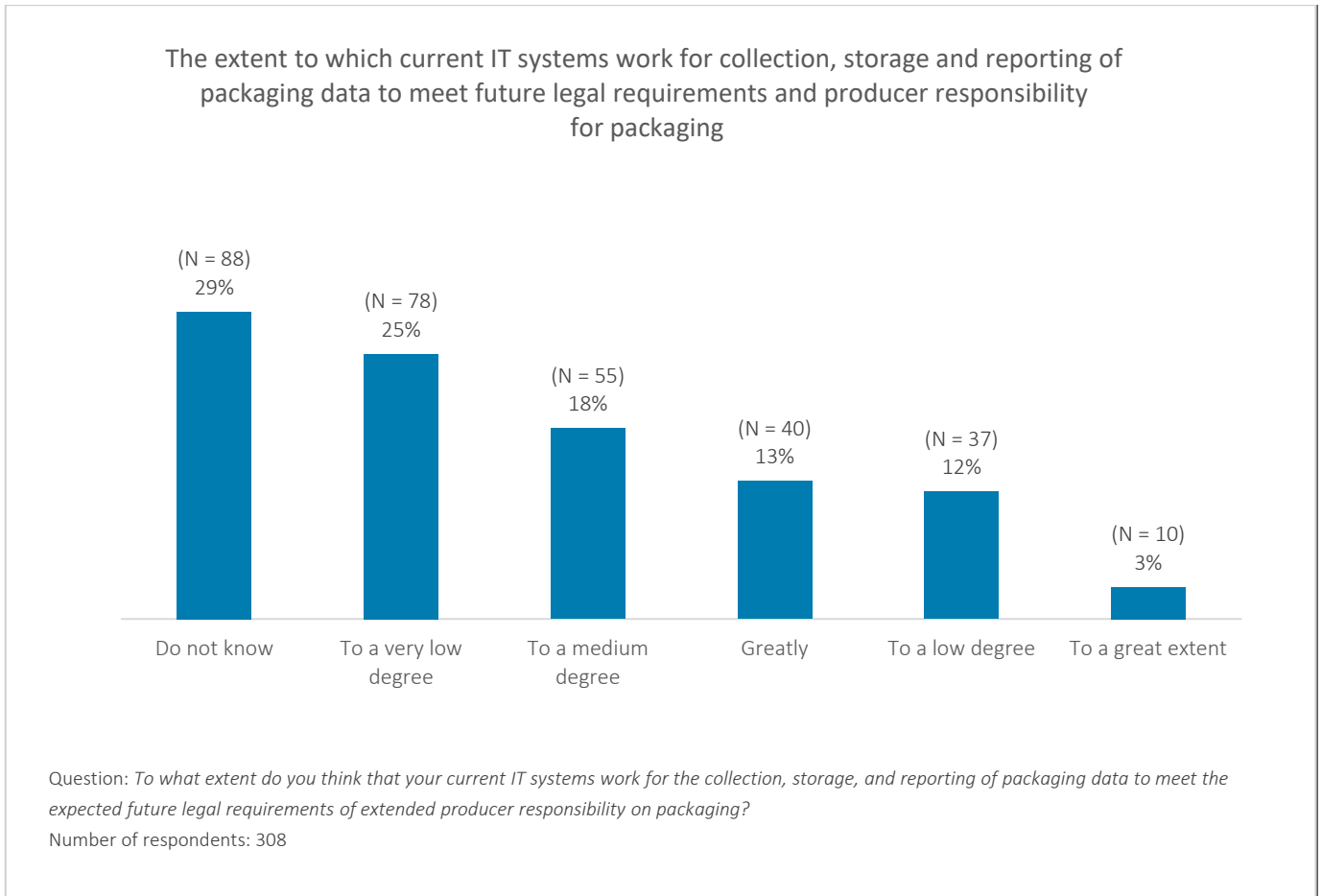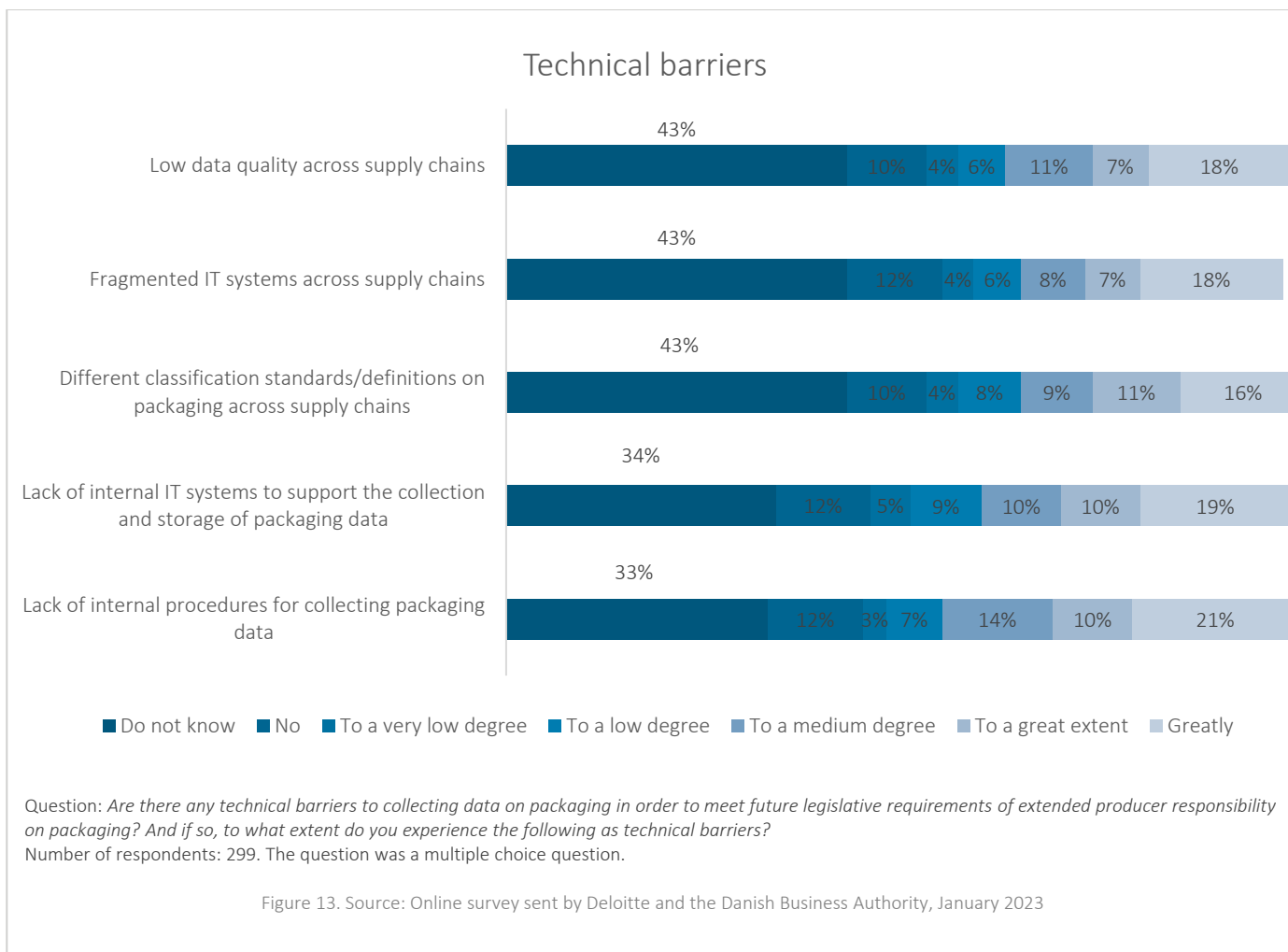Number of respondents: 308

Figure 12. Source: Online survey sent by Deloitte and the Danish Business Authority, January 2023

Moreover, some enterprises stated that their suppliers' IT setups were too outdated for system integrations and that these systems would remain unchanged unless it became a legal requirement for the supplier to enable such integration.

The enterprises need to better understand the tangible benefits of updating their IT systems. Also, as suppliers generally tend to be smaller enterprises, adapting and updating IT systems to meet the needs of customers (generally, larger enterprises) a commercial conversation between suppliers and customers would need to take place, given the cost of this change to suppliers. Suppliers would also, eventually, have to pass on additional costs to customers (through pricing or other commercial mechanisms).

Technical barriers

Barrier	Do not know	No	To a very low degree	To a low degree	To a medium degree	To a great extent	Greatly
Low data quality across supply chains	43%	10%	4%	6%	11%	7%	18%
Fragmented IT systems across supply chains	43%	12%	4%	6%	8%	7%	18%
Different classification standards/definitions on packaging across supply chains	43%	10%	4%	8%	9%	11%	16%
Lack of internal IT systems to support the collection and storage of packaging data	34%	12%	5%	9%	10%	10%	19%
Lack of internal procedures for collecting packaging data	33%	12%	3%	7%	14%	10%	21%

Question: *Are there any technical barriers to collecting data on packaging in order to meet future legislative requirements of extended producer responsibility on packaging? And if so, to what extent do you experience the following as technical barriers?*
Number of respondents: 299. The question was a multiple choice question.

Figure 13. Source: Online survey sent by Deloitte and the Danish Business Authority, January 2023

In the survey, enterprises especially marked 'Lack of internal procedures for collecting packaging data' (31%) and/or 'Lack of internal IT systems to support the collection and storage of packaging data' (29%) as 'to a great' or 'a very great extent' being technical barriers to meet future legislative requirements of EPR on packaging. 'Low data quality across supply chains', 'Fragmented IT systems across supply chains' and 'Different classification standards/definitions on packaging across supply chains' were chosen as barriers 'to a great extent' or 'very great extent' by around one quarter of the enterprises.

4.8 Data handling among organisations

Apart from private enterprises, we also interviewed other key stakeholders within the waste value chain, such as public authorities, local authorities, and waste management operators. Their perspectives are outlined in the sections below.

4.9 National Waste Data System - Affaldsdatasystemet

When the EPR legislation is introduced, Danish local authorities will be expected to report on volumes of packaging waste collected, treated, and recycled by waste fraction (e.g., plastics (by polymer type), cardboard, paper, wood, glass, metal (by metal type), etc.).
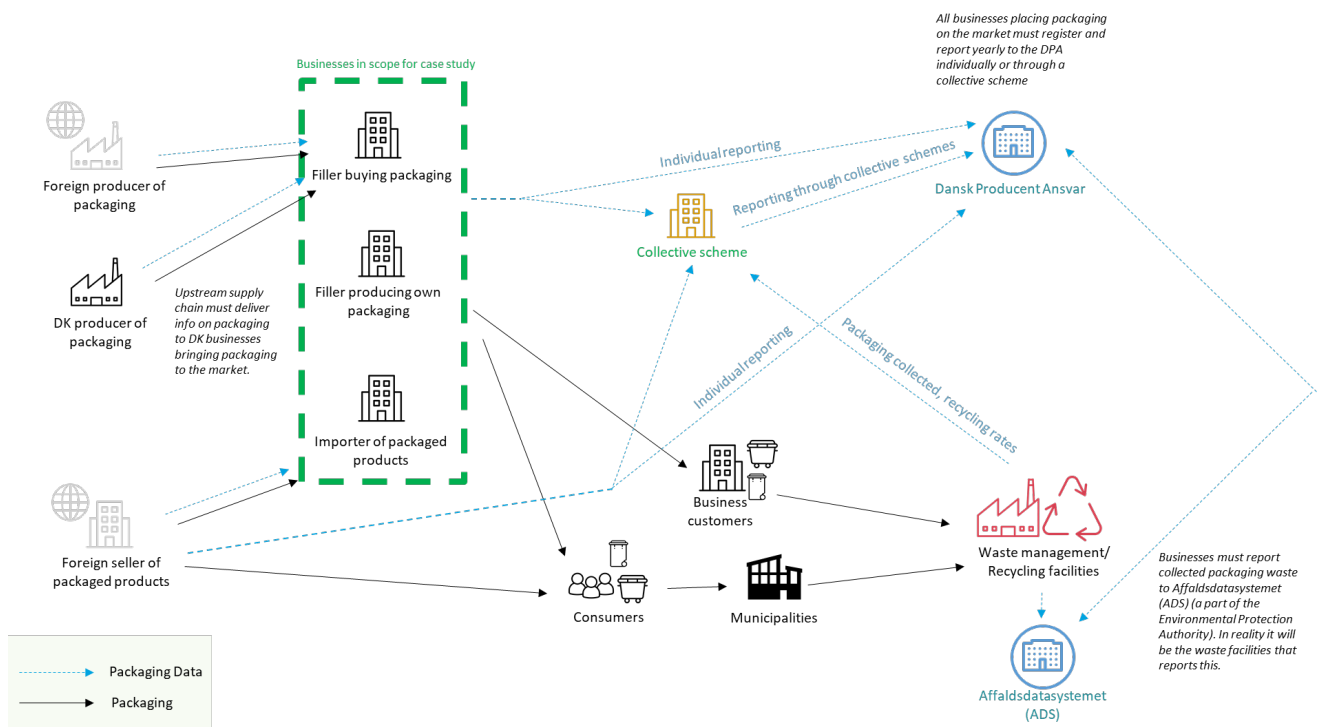
Figure 24. The likely supply chain setup of the future EPR on packaging system. Source: Deloitte

Interviewed local authorities have informed us that they already report some of the waste data required by the future EPR system to the existing Affaldsdatasystem (ADS – national waste data system) operated by the Danish Environmental Protection Agency. Data reported to the existing system includes local authority waste volumes and local authority waste fractions. At present, local authorities can report waste fractions using different waste codes, leading to complications for the waste management companies and a lack of comparability of data between local authorities. In addition, some local authorities also collect additional data from waste management companies on 'actual' waste recycling rates, but this is not yet common practice.

Local authorities have noted that they are not satisfied with the existing ADS system. The system is considered slow and to contain unreliable and unusable data. They also noted that the system does not allow local authorities to access the right waste data at the right time due to a considerable time lag between data being sent to ADS administrators by the local authorities and data being uploaded to the part of the ADS system accessible to local authorities. It has led to some local authorities across Denmark creating own data systems to track their waste data.

From discussions and interviews with relevant Danish authorities (the Danish Ministry of Environment and the Danish Environmental Protection Agency), we have gathered additional insight about the ADS system:

A. All operators in the Danish waste management chain must report to the ADS system (local authorities, waste management companies, recyclers, PROs, Danish Producer Responsibility (DPA), etc.).

B. ADS administrators (from the Danish Environmental Protection Agency) do a lot of data processing and data qualification work when they receive waste data from the operators in the waste management chain. They work to ensure data accuracy and data quality.

C. The current ADS system is not very digitalised or automated. It requires substantial human resource input to operate the current system.

D. The Danish Environmental Protection Agency would prefer a transparent and open-source data hub from which DPA, PROs, and the Danish Environmental Protection Agency each could get the data they need. It would save time for the Danish Environmental Protection Agency. It would also eliminate the problem of the Danish Environmental Protection Agency receiving aggregated data from PROs and DPA that the Danish Environmental Protection Agency would then have to check for data quality. The Danish Environmental Protection Agency also noted that the automation of data-sharing processes between the Danish Environmental Protection Agency and DPA would remove a lot of manual work-hours that are currently spent checking Excel documents received from DPA by the Danish Environmental Protection Agency.

E. Recruitment of additional staff: The Danish Environmental Protection Agency noted that they were recruiting additional staff, as the upcoming EPR on packaging would create additional work and new tasks for the organisation.

In addition, interviewed stakeholders had the following to say about the ADS system:

> "People working there spend a lot of time making sure the quality of the data is good enough. So, they pick up the phone and call the ones who have inputted the data and say: 'Why did you do that?' and 'Are you sure, this looks strange?' So, it Is very manual in the way that they're following up" *Public authority*.

And

> "They are doing different projects to make it better and more secure. They are trying to, but it is hard when you are state-funded – there is not a lot of money …." *Public authority*

4.10   Data handling - PROs and DPA

Enterprises that are members of a PRO will have their fee graded according to environmental criteria of their packaging [10] – i.e., enterprises will have to pay variable fees depending on the circularity profile of the packaging they put on the market. The members of the PROs will therefore have to report about their packaging at a detailed level. Consequently, the legislation will require reliable and verifiable data flows between manufacturers and their customers.

For enterprises already affiliated with a PRO (e.g., for compliance to the established Danish EPR regulations concerning electronics and batteries) – the reporting process entails manual data entry into the PRO's online database. Subsequently, PRO personnel download this data from the web portal and transcribe it into an Excel spreadsheet. Alternatively, the PRO's clients can provide data in Excel format directly. Following this, the data undergoes a manual review by PRO staff, a process that often demands substantial resources. At times, the PRO might need to initiate communication with clients via phone and email to address issues related to the received data.

Enterprises or PROs are required to submit packaging data, excluding information exclusively pertinent to eco-modulation, to the Danish Producer Responsibility (DPA) public organization. This submission can be facilitated either through a designated web portal or by employing a CSV file format.

DPA is an arm's-length organisation, with links to the Danish Ministry of Environment, that manages the register of producers and assigns the packaging waste fractions in certain areas to be collected.

Interviewed PROs expressed concerns about the data load that the new EPR on packaging policy would entail but also expressed concerns about the type of data/data format and the level of detail they would have to report to the DPA and ADS systems. One of the PROs said:

> "We need automation. It will not be possible to do this without it" *PRO.*

PROs, enterprises, local authorities, waste management companies, and relevant Danish authorities (e.g., the Danish Environmental Protection Agency and the Danish Ministry of Environment) want standardised/agreed-upon data standards across the entire value chain. However, since the requirements of the EPR on packaging are not yet fully defined, it is difficult to discuss the level of detail required and what to deliver. At present, several organisations[11] are trying to figure out how to make EPR on packaging happen. The interviewed enterprises are concerned about how, what, and to what level of detail they will need to report to DPA. Some of the barriers to reporting mentioned by the enterprises were the ability to obtain data from suppliers, the quality of the data received, and the lack of data standards and uniform definitions within and across the EU.

---

[10] In an upcoming ministerial resolution, the Danish Ministry of Environment will establish the criteria for eco-modulation which the PROs must include in the calculation of their members producer responsibility fees.

[11] The Danish Environmental Protection Agency, the Danish Ministry of Environment, DPA, and potential future PROs handling EPR on packaging.

The report *'Miljøgradueret bidrag for producentansvar for emballage i Danmark'* (the Danish Environmental Protection Agency, March 2023) [12] also found that it is often a demanding task for enterprises to report data to the PROs. It requires extra resources (e.g., internal finance team, internal quality control team, internal packaging team, internal ESG team, etc.) and often means that SMEs find it difficult to participate (due to lack of internal expertise/resources/time, etc.). It may lead to SMEs automatically paying a high contribution to the EPR system, as it will require fewer resources, and they are then sure not to 'cheat'/underreport to the EPR system.

DPA plans to operate the future EPR on packaging through their existing systems and believes that their current platform/database/systems will be able to handle the additional businesses that will be registered in, and will report data to, their system. DPA has not made any estimates regarding the internal or external burden for businesses/PROs in relation to the new requirements of the EPR on packaging. DPA also has not considered what they can do to minimise the burden on enterprises and PROs. DPA is awaiting the specific legal requirements of what packaging data to report and will base their new data fields on the upcoming legislation and legislative requirements. The greatest expected burden on DPA arising from the EPR on packaging will likely be advising enterprises on what to report and how to report in the DPA system. DPA plans to recruit three new employees (currently 14 employees in total) to prepare for the upcoming EPR on packaging. The new employees will be tasked to estimate the number of enterprises within scope, advising on how to adapt to DPA's current system to meet the requirements of the EPR on packaging etc.

4.11   Data handling - waste management and public authorities

Currently, the responsibility for waste management rests with the local authorities. Often, local authorities will outsource waste collection, sorting, treatment, and recycling to private-sector waste management companies. However, some local authorities still directly manage or own public companies handling waste collection, sorting, treatment, and recycling. With new Danish regulations and policies on waste management, local authorities will no longer be able to engage in waste management activities directly, and these activities will have to be outsourced to (private) waste management companies. Their responsibility will not only be to collect local authority waste and make sure that it can be recycled but also to report on and track packaging waste. With stable flows of waste and stable waste management fees/contracts over a 10–15-year period (minimum), waste management companies will be more inclined to invest in waste management/recycling facilities within Denmark. This will lead to higher domestic recycling rates, and better-quality recycled material.

As part of the following analysis, we have interviewed six waste operators about their current data on waste collection, treatment, and recycling.

Recycling rates are difficult to measure

One of the aims of EPR is to improve the packaging recycling rates. According to the interviewed waste management operators, one of the difficulties in achieving this core policy aim, is that recycling rates are currently based on a recycling facility's *monthly average of recycled material* – and not on the specific batches of packaging material recycled or on packaging material recycled from a specific brand/company. Waste management companies noted that it is all mixed together in one batch (e.g., plastics) after the waste has been collected, making it extremely difficult to track specific packaging across the value chain:

> "If you take the general sorting facilities where you have all the mixed sort of plastics, it's going to get shredded…. And then you can get some data out of it but you can never say 'that is a KiMs crisps bag'. You can only say this facility can recycle 60%. So even though the KiMs crisps bag is 100% recyclable (in theory), in the real world, it is not [due to the way that recycling facilities work]" *Waste management authority*

Due to the waste handling, it would be difficult for a producer to claim that their crisps bag is 80% recyclable (even though in theory, it may be 80% recyclable) if the average recycling rate for this type of packaging is only 50% across the waste management industry in Denmark. The waste handling limits the enterprises' ability to set specific recycling rate (actual recycling rate etc.)

> "You can't say this is from Ishøj; this is from Gladsaxe. With the way these facilities are designed right now, it is impossible" *Waste management authority*

---

[12] https://mst.dk/service/publikationer/publikationsarkiv/2023/mar/miljoegradueret-bidrag-for-producentansvar-for-emballage-i-danmark/

targets and KPIs on their packaging. Additionally, waste from one local authority is often mixed with waste from other local authorities, limiting data accuracy and traceability for specific packaging.

The same point was made by interviewees from local authorities, who raised concerns about waste from several local authorities being collected on the same route, with their own individual systems and waste schemes (fractions). Other challenges presented by local authorities were that trucks collect waste from private people and businesses and from houses and apartments on the same route, which all trigger different fees. Waste managers also pointed out that the recycling rates are batch-specific and depend on the content of the batch.

In addition, the recycling rates depend on the end-consumer's waste sorting behaviour. There is currently a lack of standardisation between what kind of waste is collected between different local authorities, and the local authorities' ability to inform the consumer about best sorting practices. One of the waste management operators said:

> *"[How will eco-modulation] take into account that the sorting plant can only sort e.g. 60%? What about the last 40%? If one pays a low fee because of PET and a lot of the fractions, [for example, end up being rejected] because of bad design or [bad smells from the product inside, will that increase the average cost of the packaging]?"* **Waste management authority**

> *"Let us say you get a truck to empty all Greater Copenhagen districts. You don't have any idea [of] the individual addresses. (..) if everybody was sorting correctly, you could recycle 80% of a truck. But [say one address] puts metal and glass together, or all kinds of stuff in their waste, then the whole truck is down to a 40% recycling rate. One household can be really good at sorting, and the neighbour can be bad at sorting, then destroying it for everybody"* **Waste management authority**

The data flow stops at the border

Another challenge described by the waste managers is that a large amount of waste is transported abroad for recycling (e.g., Germany and Sweden), and therefore cannot be tracked. The transportation takes place due to the lack of recycling infrastructure in Denmark. One of the waste operators noted:

> *"If the whole value chain in Denmark stayed in Denmark, we would have much clearer data [..] and potentially higher recycling rates"* **Waste management authority**

One of the operators mentioned that 'the data' on recycling rates is basically reported back verbally to the waste management companies when the waste is sent abroad for recycling:

EPR in Denmark may, therefore, lead to a change in the behaviour of the waste management sector in Denmark:

One of the waste management operators described the lack of standardisation across the EU as a further problem:

> *"In Denmark, it is not the same as the rest of the EU. Maybe they will streamline it in the future. When we export something that has to be recycled to another company in another EU country, they don't look at recycling the same way we do in Denmark. So, they do something and report back: 'We have recycled 80%.' But that's not the case by Danish standards, but it is the case by European standards"* **Waste management authority**

> *"[With EPR] it will be very important for [waste companies like us to have these recycling facilities nearby] because it does not make sense to transport [the waste]"* **Waste management authority**

> *"I have heard from companies saying that they would to go down and talk with an operator to get the data; it is not even data. It's just a verbal delivery of something he thinks the machine does. There is no paperwork exchanged"* **Public authority**

> *"If there were some standards and transparency within the segment, that would be very helpful for everybody"* **Waste management authority**

The operators suggested common data standards across the EU:

The Danish Environmental Protection Agency[13] also specifies in their report that other EU PROs[14] have different criteria for when packaging is recyclable and that standardisation across the EU, therefore, is important. The same view was expressed by the companies that were interviewed. They mentioned that a broad cross-country collaboration (e.g., between the Nordic governments and PROs) about the criteria would be a good idea. The report recommends that EPR not just be viewed as a producer requirement but as a broad collaboration across the value chain. One of the waste operators we interviewed pointed out that this problem might be solved over time (e.g., increasing digitalisation in Germany):

Digitalisation of data handling

> *"Since EPR is common law in the EU, facilities in Germany will also have to become more digital and automated. So, this might be better with time"* **Public authority**

Along with standardisation, waste management operators also suggested reducing the waste codes used to register packaging waste. Some operators mentioned that they currently use a variety of different and complex waste codes. They expressed concern that they would have to use more waste codes than they already do with the new legislation and would have to register 'everything' – e.g., different kinds of plastics. Currently, most data exchanges between waste management facilities, operators, and recyclers are done by email and are not very digitalised or automated. A waste management operator noted:

The waste management sector also describes a trend of customers asking them for more and more information about the treatment of their waste packaging. Consequently, it has become demanding for the waste management sector's IT and data systems. As a solution, one of the interviewed waste management enterprises has set up an API to make it easier to share data directly with customers:

> *"The industry has had the waste data system (ADS) for quite a long time. We are reporting on volumes, quantity, EACC codes, waste code, recovery code, and disposal code. Is it especially digitalised? I would not say so because what I see, especially the big industrial companies don't ask about the waste data system"* **Waste management authority**

> *"What could be feared was that we would end up with ten kinds of systems [to share all the data that customers wanted]. So, we started with this API. So, when we have a customer – and it is almost always the customers who also deal with ESG. And then when we say we want to have these data and 'I wish we would have this and this data too' and then we agree on what kind of data they want. So, we develop the platform all the time. And then we set up an API for them, with a password, so they can see the data"* **Waste management authority**

Consequences of the lack of standardisation

The consequences of the problems described above are that waste management companies generally do not think it makes sense to invest in digital tools for monitoring recycling or tracking packaging across the value chain. Another consequence outlined by the waste management companies is that they will need long-term contracts (e.g., at least 10-15 years) with local authorities for it to make sense for them to invest in recycling facilities in Denmark (currently, contracts with Danish local authorities typically run for five years). Also, waste management companies noted that high-quality sorting is not sufficiently 'valued' by Danish local authorities when they assess tenders from waste management companies. As long as there is no standard definition of 'high-quality' sorting, treatment and recycling, operators within the sector may claim that they 'do sorting, treatment, and recycling', regardless of the quality of this sorting, treatment, and recycling. One of the waste managers explains:

---

[13] *Miljøgradueret bidrag for producentansvar for emballage i Danmark, the Danish Environmental Protection Agency, p.11:*
https://mst.dk/service/publikationer/publikationsarkiv/2023/mar/miljoegradueret-bidrag-for-producentansvar-for-emballage-i-danmark/
[14] NIRAS has (on behalf of the Danish Environmental Protection Agency) interviewed operators in Sweden, Germany, the Netherlands, Belgium, and France.

"You [can just] melt down all the plastic in one pot and say, it has been recycled, but you can never recycle that material again. (...) recycling is a big, fluffy thing. (...) We need some standards because if we bid with high-quality sorting, we don't get extra points because some of these guys can just melt down the waste" **Waste management authority**

Currently, only a few of the local authorities that we interviewed asked the waste collectors for data on recycling rates. In the future, the local authorities that we interviewed will most likely require their waste collectors to recycle a certain percentage of collected waste (due to requirements from other EU regulations, e.g., the Waste Framework Directive). For example, with the EPR on packaging and eco-modulation of producer fees, producers will have a direct financial incentive to select packaging that can be recycled more easily. In turn, local authorities will charge producers (via PROs) for collecting and recycling the producer packaging.

Local authorities were concerned that waste management companies would only aim to recycle the requested percentage of collected waste packaging. Local authorities were also concerned that waste management companies might also claim to recycle more than they actually do, with 'actual' recycling rates being difficult to verify.

Accurate data on collection and recycling will be important to justify the EPR fees that are ultimately passed on to producers. Packaging that is easier for local authorities (via waste management companies) to collect and recycle will cost less to collect and recycle; hence local authorities will be required to pass on these lower fees to producers (via PROs).

4.12   Conclusions

From the results of the surveys and interviews undertaken, we found substantial challenges in the maturity level of Danish enterprises on the ability to report the required packaging data, as well as challenges for both the private and public organisations having to handle all the data being reported by enterprises. Although some enterprises collect packaging data, the processes of data collection and data handling tend to involve a lot of manual work and for smaller enterprises their current systems will (in current versions) not be able to handle the new data requirements.

A summary of our high-level conclusions reflects the complexity of the as-is situation:

A. A large amount of manual work is involved in data management by enterprises, PROs, local authorities, and waste management companies. Hardly any of them have automated processes to retrieve or reformat data.

B. Enterprises have difficulty in obtaining data on packaging from their suppliers, a manual process without any standard data formats.

C. Legal requirements and customer enquiries are the main drivers for collecting and storing data.

D. There are a number of barriers identified by the enterprises to digitalise their processes, such as resource capacity, costs and the difficulties associated with gathering accurate recycling data.

E. Larger enterprises tend to collect more packaging data and are more digitally mature in their way of collecting and storing data than SMEs, given that they often report on packaging in other countries. They structure their data better, have more financial resources, and are more willing to invest in additional IT systems, tools, and human resources.

F. Enterprises are worried about the upcoming EPR legislation and the lack of finalised requirements and do not believe that their current system will be able to help them comply with the requirements.

G. The tracking of waste is difficult with the current setup as e.g., the data flow breaks at the border when the waste is handled in other countries.

5. Appendix - Methodology

The methodology of the analyses is based on a mixed methods design, in which quantitative and qualitative methods supplement each other. The quantitative data foundation is a large survey with 497 enterprises in total, completed between 10 January and 10 March 2023. To back up and explore the survey results, we conducted 44 interviews, four observations, one workshops (with ten organisations, supported by desktop research from October 2022 to March 2023. The data collection is shown in **Error! Reference source not found.** below.

Interview were conducted with 19 enterprises, 8 public authorities, 5 business associations, 4 PROs, 3 interest organisations, 2 waste management authorities, 2 IT vendors and 1 external expert.

In the following, the methodology for each data collection method will be described.

5.1 Desktop research

A desktop review was undertaken to ensure the analyses was building on existing expertise and knowledge. Deloitte utilised material provided by the Danish Business Authority (and other Danish public authorities), as well as research and expertise from Deloitte colleagues. Research was undertaken on current and upcoming Danish and EU legislation, current Danish EPR systems, EPR on packaging in other countries, and reports on eco-modulation and recycling of packaging materials.

5.2 Quantitative approach

The primary aim of the survey was to obtain broad-scale responses regarding the types of data currently being collected by enterprises, how this data is registered and shared across the value chain, and the expected burden of collecting additional data and reporting due to forthcoming legislation.

5.2.1 Sample

We conducted a comprehensive segmentation to ensure that we obtained outcomes from relevant enterprises that currently are, or will be, impacted by the forthcoming legislation. This segmentation ensured that our enterprise sample included relevant sectors and a distribution of company sizes that reflected the population expected to be affected by the legislation.

The comparison between the segmentation and the sample from the survey is shown in Figure 12 and **Error! Reference source not found.**2. We generally find the enterprises to be representative of the business population.
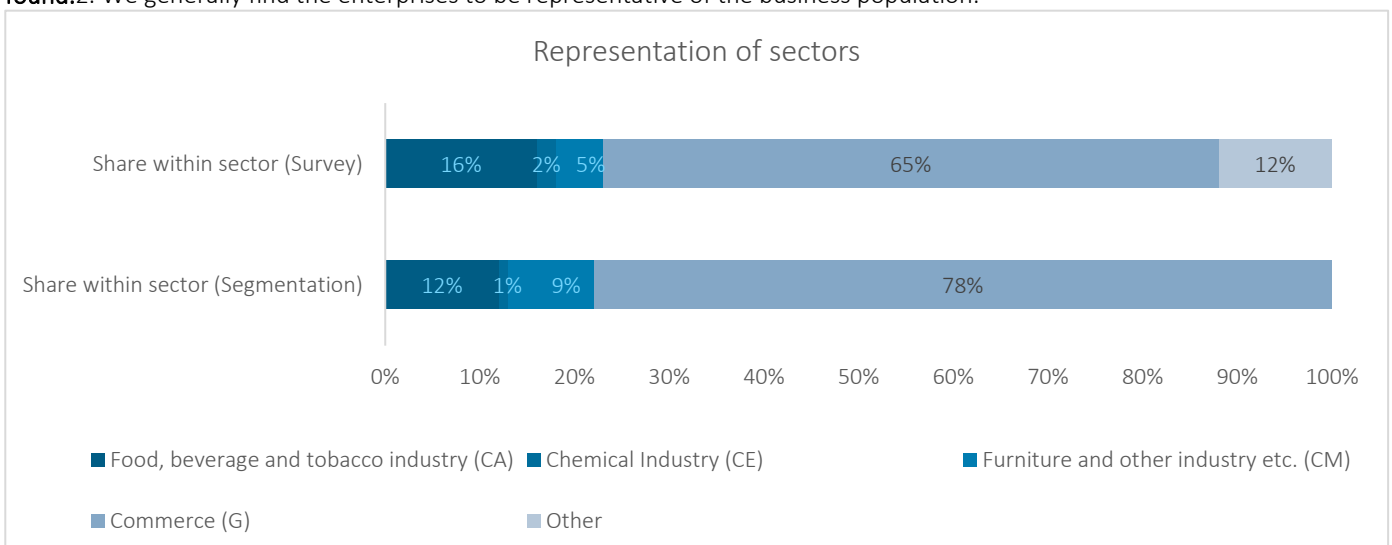

Figure 32. Source: Online survey sent by Deloitte and the Danish Business Authority, January 2023

In total 3.816 enterprises were identified in the segmentation and with 497 responses, we obtained a response rate of 13%, as shown in Table 2 below.

Table 2. Overview of sample size and response rate for surveys	
Sample size	3,816
Survey responses in total	497
Completed	290
Partly completed	207
Response rate	13%

5.3 Validity and reliablity

To ensure the reliability and validity of our analysis, we implemented several precautions throughout the data collection process and the analyses. For both the quantitative and qualitative methods, we conducted a thorough segmentation to ensure our samples included a broad range of players from relevant sectors. Upon comparing our segmented sample with the survey results, we found that the survey overall was representative of the segmented samples. Furthermore, as displayed below, we generally observed coherence among the data from the surveys, the interview responses, the observed actions, and existing research in the field. By achieving high response rates and conducting a significant number of interviews, our assessment is that the data collection and analysis demonstrate a high level of validity and reliability. In the following, we will go through the steps we implemented to ensure the validity of the results.

5.4 Quantitative approach

To ensure the validity of the survey results, we have taken the following steps before and after the survey was launched:

Before:

A. Prior to finalising our survey questions, we conducted a comprehensive review and validation process involving more than ten professionals from Deloitte and DBA. It ensured that each question was interpreted consistently and ambiguous questions were eliminated.

B. Because the survey included questions related to potential future legislation, there was a risk that respondents might interpret the expected legal requirements differently. To address this concern, we included relevant information and diagrams in the survey to provide participants with a clearer understanding of the requirements. We also simplified the language used in the survey to ensure that all participants could grasp the implications of the legislation for their company. Nevertheless, during our subsequent analyses, we identified instances, in which some enterprises appeared to have misunderstood the legislation's requirements (see the *Validity analysis* section below).

After:

A. To ensure that the survey participants represented the population being analysed, we conducted a segmentation analysis that compared the size and sector of the enterprises surveyed to identify potential bias in the responses (see the *Sample* section above).

B. In exploring the validity of the results, the questions were compared to the data from the interviews. Since we had enterprises participating in both the survey and the interviews, we could explore the answers to the survey questions, and get an indicator of questions that might have been understood differently, which we could take into account when analysing the data. We did some controls, in which we compared the answers to specific questions with the answers the enterprises had given in the background questions. See more below.

Cross-checks of data-sources

In the following, some notable results from our comparison of quantitative and qualitative data-sources are displayed. These outcomes do not, in our opinion, threaten the validity of the data and the knowledge derived from it. We display these facts for transparency reasons, to make the reader aware of this occurrence during our data gathering phase.

'Other' categories without meaningful responses

During our content analysis of the free text fields in the survey on packaging data (EPR), we discovered that many enterprises had selected the 'other' category but had either not provided any relevant input (e.g., 'food waste') or left the text field blank. As a result, we removed the 'other' category from all multiple choice questions related to the collection of packaging data when we found that it contained no meaningful responses.

Varying perceptions of packaging amounts

During our interviews with enterprises about the upcoming EPR legislation, a few SMEs realised that they had misunderstood the concept of packaging. Consequently, some placed themselves in the 'above eight tons' category during the interview, while they had previously indicated 'below eight tons' in the survey. We found that the reason for the misperception was a lack of familiarity with EPR and the differences in packaging standards (e.g., primary packaging in Denmark may differ from that in the UK). However, as we did not observe this to be a prevalent pattern among the participating enterprises, we factored this information into our data analysis and presented it at the outset of our analysis to apprise the reader.

5.5 Qualitative approach

While the survey results help us to quantify and generalise processes and behaviours of the enterprises, a limitation of survey results is that they, due to the questionnaire structure, only give limited insights into complex processes. As a result, we have also adopted a qualitative approach, which will be explained below.

5.5.1 Selection strategy

Like in the survey approach explained above, we conducted a comprehensive segmentation analysis to make sure that our sample consisted of relevant enterprises, interest organisations, experts, public players, etc.

In the survey we asked the participants whether they wanted to participate in follow-up interviews, and those that responded positively were invited to an interview while we continuously verified the background information of the enterprises to ensure that they met the segmentation criteria. Moreover, the survey results provided additional information for the interview segmentation, such as potential businesses above or below eight tons (volume of packaging placed on the Danish market per year) and those reporting individually or through a PRO.

5.5.2 Interview approaches

The following methodological approaches were taken before, during, and after the interviews:

Preparation of the interview guide: We approached the interviews with a semi-structured, explanatory interview guide. We did not rigidly follow a formalised list of questions but rather posed open-ended questions that allowed the interviewees to elaborate on their experiences. The interview guide was reviewed by experts from Deloitte and DBA.

Conduct of interviews: The interviews were conducted by two consultants, which prevented subjectivity in the study. Most interviews were conducted online or by phone – a few interviews were conducted physically at the respondent's location. We ceased data collection when we determined that the data had reached the *theory-saturation* point – a judgment that we would not gain further knowledge by conducting additional interviews.

Analysis of interviews: The analysis utilised a cross-sectional approach, which provided an overview of the themes frequently emerging across the interviews. The themes from the interviews were compared to knowledge from other studies and information that already existed in the field, as well as the results from the conducted surveys.

5.5.3　　Observations

Along with interviews and the survey, we employed ethnographic observations to examine whether the data collected from the interviews aligned with the actual words and actions of the respondents concerning the registration and reporting of data. We observed professionals carrying out their roles and utilising existing systems within their respective environments, allowing us to gain a human perspective on the current situation. This approach facilitated a contextual enquiry, enabling us to observe specific behaviours and gather feedback on why certain actions were being taken.

Deloitte.