Netherlands Institute
for Sustainable Packaging

FACT SHEET

Beverage Cartons

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Beverage Cartons

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1. Introduction

What aspects of sustainability are important with regard to beverage cartons? How are beverage cartons recycled?

KIDV often gets asked these and other questions about beverage cartons. To answer these questions, KIDV has drawn up this fact sheet.

2. What is this fact sheet about?

KIDV provides a general overview of the state of affairs with regard to beverage cartons in the Netherlands. Further details and more in-depth information can be found in the reports that are referenced in this fact sheet.

Beverage cartons are defined in The *Packaging Decree*[1] as 'packaging suitable for packaging liquid food, other than drinking cups, of which paper or cardboard is the main component'. There has been a recycling target for beverage cartons since 1 July 2023; it is 34% for 2023 and increases to 55% in 2030.

This fact sheet describes the current state of affairs with regard to the collection, sorting, recycling, circularity and environmental impact of beverage cartons. It also covers identified opportunities and difficulties. This fact sheet will be updated if and when new waste sorting and recycling techniques, new materials or new policies are introduced.

KIDV created this document with the utmost care and attention. Nevertheless, we would greatly appreciate it if you would let us know if the document is incomplete or incorrect in any way (info@kidv.nl). KIDV assumes no liability for any damage resulting from or related in any way to the use of this document.

[1] More information: Packaging Decree (only available in Dutch).
[2] The Ministry of Infrastructure and Water Management is working on a recycling target for beverage cartons. During the preparatory internet consultation, it became clear that the definition of beverage cartons may be revised.

3. Main Conclusions

1. In the Netherlands, beverage cartons are primarily used to package liquid food products (dairy products, juices, soups, sauces and water). What sets the Netherlands apart from many other countries is that beverage cartons are also used to package viscous dairy products. The larger amount of product residue poses additional challenges during sorting and recycling.

2. The use of beverage cartons in the Netherlands has decreased from ±70 kt in 2013 to ±55 kt in 2020. According to Wageningen Food & Biobased Research, the recycling percentage for beverage cartons was 31% in 2020. Only the paper fibres were recycled and not reused to make new beverage cartons. With fully optimised collection, sorting and recycling processes – including PolyAl - a maximum recycling percentage of 52% can be attained. PolyAl is a combination of plastic and aluminium.

3. At the moment, beverage cartons have reasonable recyclability according to KIDV. This assessment is based on the information that is currently available and which is described in this fact sheet. The biggest challenge comes from recycling PolyAl. If the targets defined by the industry are realised, KIDV believes it to be possible for beverage cartons to attain good recyclability.

4. History, Use and Composition of Beverage Cartons

The first beverage cartons were developed in the 1950s by Tetra Pak. The initial design consisted of a pyramid-shaped packaging made of cardboard with a plastic layer. The rectangular beverage carton that is popular today - the so-called brick - was first introduced about sixty years ago[3]. It was developed by Tetra Pak and became a major success because of its efficient shape. These days, there are various suppliers of beverage cartons in Europe, i.e. Tetra Pak, Elopak and SIG Combiblock.

4.1 Use

Beverage cartons are used for a wide range of applications. In the Netherlands, they are used to package liquid food products such as dairy products, juices, soups, sauces and water. Beverage cartons are sometimes also used to package dry products. It is essentially unique for the Netherlands to also use beverage cartons to package viscous dairy products, such as custard and yoghurt. This is hardly done in other countries.

In the Netherlands, circa 55 kt[4] of beverage cartons are put on the market every year. The majority of these beverage cartons (circa 55%) are used for chilled food products[5], such as fresh dairy. The remaining 45%[6] are used for shelf-stable products such as juices. This so-called aseptic packaging (protecting against the development of pathogens) gives products a long shelf life without the need to refrigerate the product.

4.2 Composition

Beverage cartons consists of various layers. The primary layer is made of paper. This paper is laminated with a layer of LDPE (low-density polyethylene) and possibly aluminium. A beverage carton may also have a cap. These caps are usually made of PE (polyethylene) and sometimes of PP (polypropylene). In some cases, the "shoulders" of the beverage carton are also made of plastic.

[3] More information: Tetra Brik.
[4] Thoden van Velzen, E. U., & Smeding, I. W. (2022). Recycling van Nederlandse drankenkartons. (Report / Wageningen Food & Biobased Research; No. 2275). Wageningen Food & Biobased Research. https://doi.org/10.18174/567789 (only available in Dutch).
[5] Source: Hedra presentation of 24 August 2022.
[6] Source: Hedra presentation of 24 August 2022.

On average, aseptic beverage cartons for shelf-stable products have the following composition:

- 78% paper (new, long fibres);
- 20% LDPE for the plastic layer and/or HDPE (high-density polyethylene) or PP for the cap and shoulder;
- 2% aluminium.

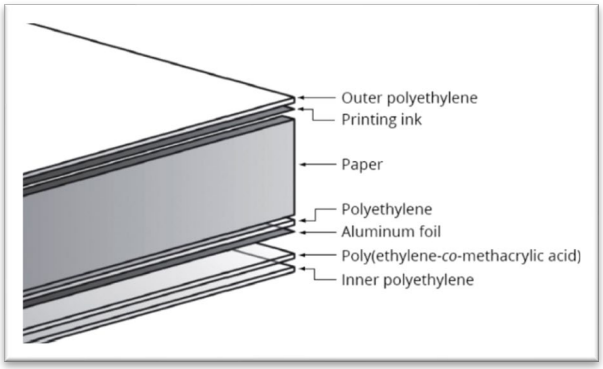


Figure 1 Schematic overview of a beverage carton with a layer of aluminium. (Recycling of Aseptic Beverage Cartons: A Review, Gordon L Robertson)

Beverage cartons for chilled products do not feature a layer of aluminium, only LDPE.

A beverage carton with a cap and a volume of one litre weighs over 30 grams[7].

4.3 Market Developments

In the retail sector, there is an ongoing transition towards the use of packaging that either contains a larger percentage of natural fibres or which is made entirely out of plastic. Such transitions occur gradually; they are usually the result of targets that businesses set for themselves, e.g. targets aimed at material reduction, improving circularity or reducing environmental impact. Sometimes, existing regulations or the impending introduction of new legislation form the driving factor behind these transitions.

In 2022, Wageningen Food & Biobased Research studied the recycling of beverage cartons in the Netherlands by order of the Ministry of Infrastructure and Water Management. Based on figures available on the market, the study revealed a decline in the use of beverage cartons: from circa 70 kt in 2013 to 55 kt in 2020[8].

Manufacturers of beverage cartons are working on a number of developments, such as aluminium-free beverage cartons for shelf-stable products. For these beverage cartons, materials other than aluminium are used to create a barrier. Examples of such materials are EVOH (Ethylene Vinyl Alcohol), SiOx (Silicon Oxide) and AlOx (Aluminium Oxide)[9].

[7] Source: Packaging barometer KIDV, 2019.
[8] Thoden van Velzen, E. U., & Smeding, I. W. (2022). Recycling van Nederlandse drankenkartons. (Report / Wageningen Food & Biobased Research; No. 2275). Wageningen Food & Biobased Research. https://doi.org/10.18174/567789 (only available in Dutch).
[9] Source: SIG-combiblock presentation of 5 July 2022.

Fossil resources are generally used for the production of LDPE. However, it is also possible to produce LDPE with biomass (e.g. sugar cane). This biobased LDPE is also used in the production of beverage cartons. The properties of biobased LDPE are virtually the same as those of fossil LDPE and it is used in the laminate in a similar manner[10].

Figure 2 Example tethered cap

Another ongoing development is the increased use of so-called *tethered caps*[11]. These are hinged caps that stay attached to the beverage carton after opening the packaging. The SUP guideline (only available in Dutch) states that (composite) beverage packaging (which contains a beverage) must feature caps and lids that remain attached to the packaging during use beginning 3 July 2024.

[10] More information: Green Deal Green Certifications - Best practices.
[11] More information: Packaging Insights, Tetra Pak - Tethered caps, SIG - Tethered caps.

5. Recyclability

KIDV defines recyclability as the process of collecting, sorting and recycling a packaging and using the recycled material to make new products or packaging[12].

At this time, KIDV defines beverage cartons as having *reasonable* recyclability. If the aforementioned targets defined by the industry are attained, KIDV believes it to be possible for beverage cartons to be classified as having *good* recyclability.

5.1 Overview of the chain

Figure 3 shows a schematic overview of the recycling of beverage cartons in the Netherlands, according to Hedra. Hedra is the Dutch sector organisation for suppliers of beverage cartons.

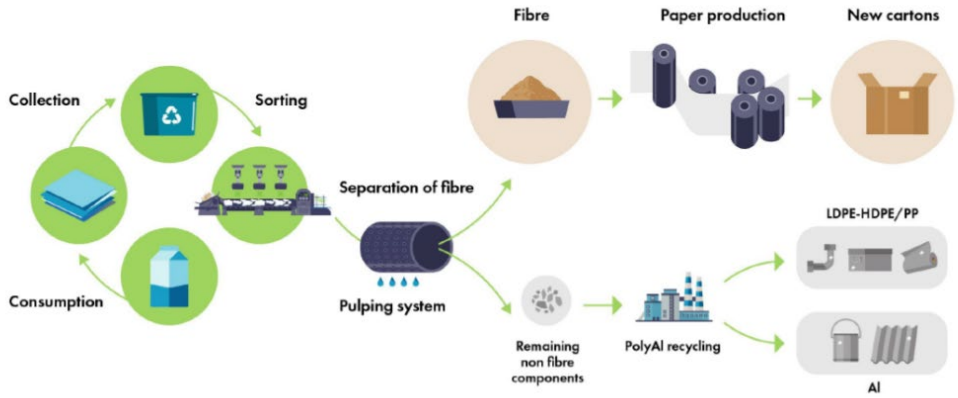
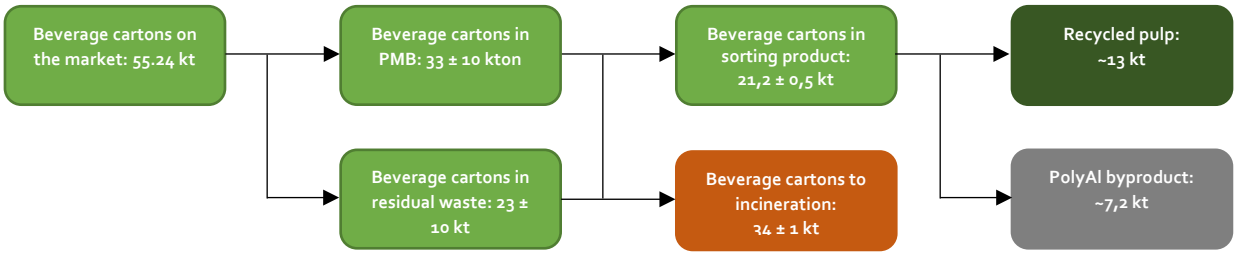


Figure 3 Overview of the stages of the chain, visualised by Hedra

Figure 4 offers a schematic overview of the various stages of the chain, as developed by Wageningen Food & Biobased Research (WFBR). The study (only available in Dutch) conducted by WFBR revealed that only the paper in beverage cartons was recycled in 2020. The average recycling percentage for beverage cartons was calculated to be 31%. According to the study - which used data from 2020 - a maximum recycling percentage of 52% can be attained under ideal (and theoretical) circumstances.

[12] The full definition of recyclability can be found in the various KIDV Recycle Checks.



Schematic chain picture for Dutch beverage cartons in 2020. Weights shown are net (i.e. after deducting other materials (plastic, glass, metal, etc.) and adhering moisture and dirt). This means that most numbers have been calculated with known ratios, images and coefficients

Figure 4 Schematic overview from Recycling of Dutch beverage cartons, Wageningen Food & Biobased Research

5.2 Collection

In the Netherlands, beverage cartons are primarily collected via source separation (via the PMB stream in many municipalities, i.e. plastic and metal packaging and beverage cartons) or as part of the household residual waste stream. During the sorting process, beverage cartons are separated from other waste with the help of NIR (Near Infra Red) scanners. Note: not all beverage cartons that end up in the household residual waste stream are removed via subsequent separation.
The separate collection of beverage cartons was introduced in 2015. Of the material collected, 79%[13] is currently collected via source separation and the rest via subsequent separation.

5.3 Sorting

After collection, the beverage cartons are sorted out of the PMB stream or the household residual waste stream and compressed into bales. In the case of beverage cartons used to package viscous dairy products, the larger amount of product residue in the packaging creates additional problems during the waste processing stage in terms of odours and vermin. As a result, not all waste sorting facilities accept this material. Innovations are being worked on to mitigate these problems, such as chilling the bales.

5.4 Recycling

Although the process of recycling beverage cartons is similar to that of recycling paper and cardboard, it is performed by paper plants with special facilities. Such plants are not found in the Netherlands, but some other European countries do have them. At the moment, the Netherlands sends its material to Germany.

[13] Source: Hedra presentation of 24 August 2022.

Since the cardboard used for beverage cartons is laminated on both sides, the recycling process contains an additional step to separate the aluminium and the LDPE from the paper fibres. This process creates three material streams:

- Paper fibres
- Rigid HDPE and PP from the cap and the shoulder
- A combination of LDPE and aluminium (PolyAl)

The paper fibres are soaked in a so-called pulper, after which they can be reused to produce new products and packaging. Examples include tissue paper and cardboard boxes. The recycled fibre material cannot be used for applications where it would directly come into contact with food. To make this possible, a functional barrier[14] must be applied to the cardboard.

The stream of rigid HDPE and PP is initially taken to the next recycler along with the PolyAl, where the two are then separated. The rigid HDPE and PP can also be reused to produce new products and packaging.

The remaining material stream (the PolyAl) is processed by the recycler. To date, this stream has proven to be difficult to recycle properly. New installations are being built to separate the plastic and the aluminium and to make them suitable for new applications. These installations are currently in the pilot phase; they are expected to be scaled up by late 2022/early 2023. At the moment, PolyAl is primarily used as fuel in the cement industry.

[14] A functional barrier is a so-called separation layer that separates the packaging material from the packaged food product in order to prevent any displacement from the packaging material into the food product.

6. Circularity

Circularity is about closing the cycles. Properly closed cycles are those without any material loss. The goal is to optimise the quality of materials. During their first use, the materials used for the production of beverage cartons (paper fibres, LDPE and aluminium) are suitable for food-grade applications. After recycling a beverage carton, these materials are no longer suitable for direct contact with food products. This necessitates the use of a functional barrier.

As with other paper and cardboard packaging, the paper fibres experience a certain degree of degradation each time they are recycled. The fibres can be reused between seven and twenty-five times[15], albeit not for applications where they would come into direct contact with food products. Improvements have been made with regard to the application of the paper fibres. In the past, a percentage of the fibres was used for the production of hygienic paper[16], which has no new applications (yet) after use. These days, recycling plants also use the fibres to produce corrugated board. This allows the fibres to go through more *loops*, compared to the one-time use of hygienic paper.

The rigid HDPE and PP can be reused for (non-food) products and packaging. Provided that the new product or packaging is designed well, it can be recycled once more after use. This allows the material to go through multiple *loops*. The same is true for the PolyAl and the aluminium component. See the section on 'Difficulties' for more information about possible applications.

7. Environmental Impact

Various aspects affect a packaging's environmental impact. The main goal is to curb the emission of greenhouse gases. Among the contributing factors are the choice of raw materials, the efficiency of the packaging during transport, the (im)possibility of reusing the packaging and the total volume of packaging which is recycled.

It is not possible to make an overall comparison between packaging concepts made from different materials. This requires a life cycle analysis (LCA) that describes a specific product-packaging combination. Based on research conducted by the Institut fur Energie- und Umweltforschung (IFEU), it can be said that the environmental impact of beverage cartons is lower than that of other packaging solutions[17].

[15] More information: Packaging Europe.
[16] More information: Hedra - From beverage carton to hygienic paper (only available in Dutch).
[17] In 2018, the FKN (Fachverband Kartonverpackungen für flüssige Nahrungsmittel; the German interest group) had the environmental research institute IFEU conduct LCAs for 1- and 1.5-litre beverage cartons for juices and milk. Beverage cartons were compared to single-

Various general aspects that are relevant to beverage cartons are listed below:

- Flat-packed or rolls of beverage cartons are shipped to production plants, where they are then formed, filled and sealed. This means a single truck can transport a large number of empty packaging. This efficiency results in a low carbon footprint during the transport stage.
- A study conducted by Wageningen Food & Biobased Research in 2013 shows that collecting and recycling beverage cartons provides environmental benefits compared to processing the beverage cartons in a waste incineration plant. The environmental benefits have a strong correlation to the volume of collected material. On a global scale, the environmental benefits of collecting and recycling beverage cartons are significant and similar to that of collecting and recycling plastic[18].
- The fibres that are used in the production of beverage cartons are a renewable raw material and come from FSC-certified forests (Forest Stewardship Council)[19].
- Plastic can be either fossil-based or biobased and it is used by all suppliers. See the KIDV Fact sheet on biobased plastic packaging for additional background information[20].
- The aluminium layer in beverage cartons always consists of virgin material. The production of aluminium from virgin material has a large carbon footprint[21]. The vast majority of the CO_2 is released during the extraction of the raw materials and the production of the aluminium.
- When packaging is used outdoors, there is an inherent risk of littering. This has a negative environmental impact.

use bottles and returnable bottles. This report was reviewed by the German Environment Agency (Umweltbundesamt - UBA) to safeguard its neutrality and subsequently revised based on the LCA that was released in 2020. The final conclusion of this LCA is that the carbon footprint of beverage cartons used for juices is similar to that of glass returnable bottles. Beverage cartons used for fresh milk have a lower carbon footprint. More information: report Institut für Energie- und Umweltforschung (IFEU).

[18] More information: KIDV final report pilot beverage cartons.

[19] More information: SIG - Certifications, Tetra Pak - Supporting sustainable forestry, Elopak - Sustainable forestry.

[20] KIDV fact sheet Biobased plastic packaging.

[21] More information: Ecolizer catalogue - Aluminium (only available in Dutch).

8. Difficulties

Various considerations have to be made when choosing packaging for a specific product. It is good to have insight into the difficulties associated with a specific type of packaging and packaging material. With regard to beverage cartons, the following difficulties must be taken into account:

- Acceptance

  Viscous dairy products

  Some recyclers of beverage cartons do not accept material from beverage cartons used in the Netherlands because product residue from viscous dairy products causes problems regarding odour and vermin. The Netherlands is fairly unique in its use of beverage cartons to package viscous dairy products. In other countries, beverage cartons are primarily used to package fluid dairy products (milk), juices and water. On average, a beverage carton used for a viscous dairy product will contain 19-50 grams of product residue[22].

  Transport restrictions

  The European Waste Shipment Regulation (EVOA)[23] imposes restrictions on the transport of waste . These complicate the process of transporting bales of beverage cartons. Since beverage cartons also come from subsequent separation, they may contain additional contaminants. As the Netherlands has no recycling capacity for beverage cartons, they must be exported and the receiving party must have a licence to accept this 'waste'. Only a small number of paper plants are willing to accept beverage cartons under these conditions.

- Recycling PolyAl

  At the moment, there is only a small number of recyclers who process PolyAl. Most recycling plants are still in the development and test phase or only operate on a pilot scale. Rigid plastics can be extracted from the material and reused for the production of new products or non-food packaging. The organisations each have their own technique (with varying degrees of efficiency) for separating the LDPE from the aluminium. Some applications are already available on the market. In other instances, (better) applications for the material are still being explored. Although other recycling methods are being developed internationally, these are not yet utilised on a large scale[24].

  The remaining PolyAl stream is primarily used as an energy source for cement ovens. This

[22] Thoden van Velzen, E. U., & Smeding, I. W. (2022). Recycling van Nederlandse drankenkartons. (Report / Wageningen Food & Biobased Research; No. 2275). Wageningen Food & Biobased Research. https://doi.org/10.18174/567789 (only available in Dutch). This conclusion is supported by data from the KIDV Packaging Barometer.

[23] More information: Cross-border waste transport (EVOA; only available in Dutch).

[24] More information: Recycling of Aseptic Beverage Cartons: A Review.

processing method offers a benefit for cement manufacturers, as the carbon emissions from the incineration process can be omitted from their own carbon accountancy.

- Litter is a problem that affects all packaging where the packaged product is consumed outdoors. There is an ongoing debate about litter and the role beverage cartons play[25].

9. Conclusion

KIDV continues to closely monitor developments pertaining to beverage cartons. This fact sheet will be updated if and when there is reason to do so. If you would like more information about the sustainability of packaging, you can submit your question to KIDV's Help Desk.

[25] More information: Letter to Parliament about "Progress deposit scheme for cans and motion beverage cartons" (only available in Dutch), article in Trouw "Supermarkets cheat with deposits on plastic bottles" (only available in Dutch), memo monitoring beverage cartons in litter (only available in Dutch).

Background Information

Wageningen Food & Biobased Research – Recycling of Dutch beverage cartons

Thoden van Velzen, E. U., & Smeding, I. W. (2022). Recycling van Nederlandse drankenkartons. Report Wageningen Food & Biobased Research; No. 2275). Wageningen Food & Biobased Research. https://doi.org/10.18174/567789 (only available in Dutch).

Sector Organisations

The Netherlands: www.hedra.nl

Europe: www.beveragecarton.eu

Production of Beverage Cartons

Zakboek verpakkingen, Ten Klooster et al. – *Line aspects of beverage packaging*.

Appendix

Targets of Trade Associations for Beverage Cartons

ACE (the Alliance for beverage cartons and the environment, the European interest group for producers of beverage cartons) has set a number of targets for 2030 with the goal of improving the collection of beverage cartons and the recycling of fibres and PolyAl. See the image below.

ACE's goal is to recycle more than 700 kt of fibres in Europe by 2025. In 2019, this figure was circa 450 kt. For PolyAl, plans have been presented to recycle 160 kt by 2025. The first recycling plant - with a capacity of 20 kt - was opened in 2020.[26, 27].

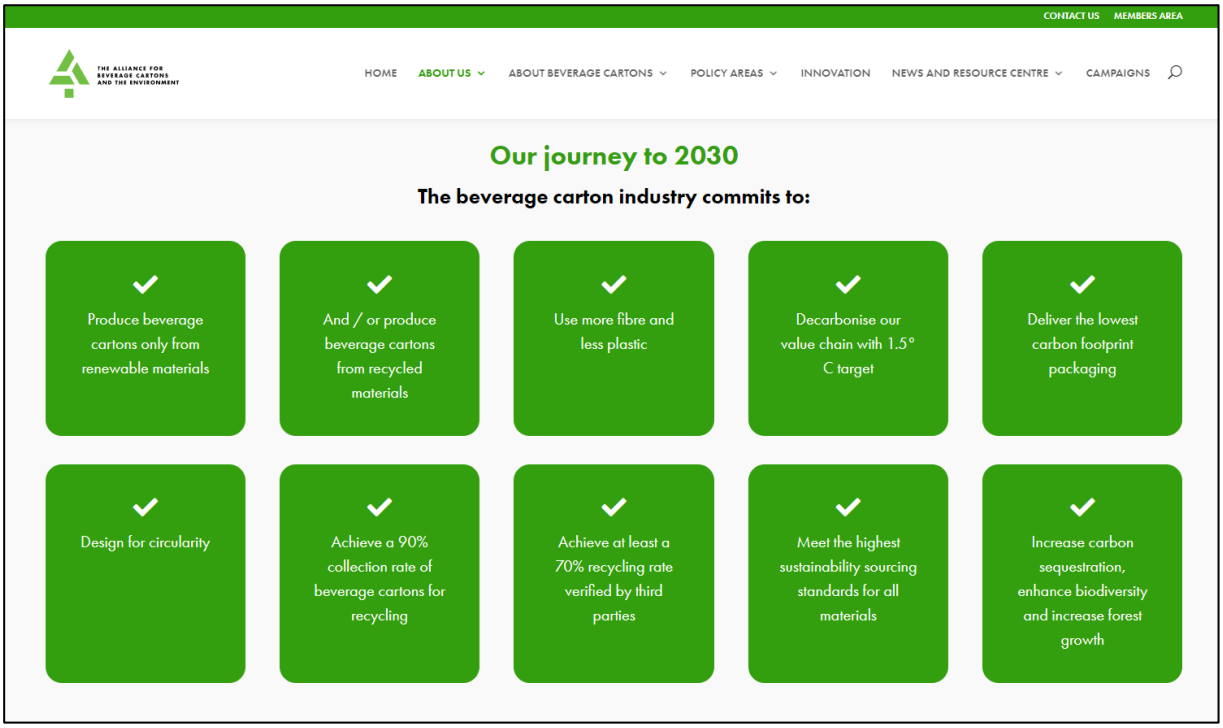


Figure5 Screenshot of ACE's Website

[26] Source: Hedra presentation of 24 August 2022.

[27] More information: Beverage cartons – Facts & figures of recycling (only available in Dutch).