Climate Footprint of Public Procurement, 2019

Strategy for Green Public Procurement

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Summary

The analysis contributes with the first calculation of the climate footprint of public procurement – in the coming years, this method must be refined

First assessment of the climate footprint of public procurement

There is great variation in what the public sector procures. In particular, the procured goods originate from many places and impact the climate in different ways and to varying degrees. The exact knowledge of the climate impact does not exist today - although various operators have previously attempted to assess it[1]). This analysis contributes with the first calculation of the climate footprint of procurement in the public sector in 2019[2]).

A first step – but the method must be refined

The assessment of the climate footprint of public procurement is not straightforward. Among other things, the calculation requires a joint assessment and unification of public procurement and the associated procurement categories across municipal, regional and government entries3). The analysis is based on a joint assessment of the public procurement on the basis of invoice data. The calculation enables an insight into the total climate footprint of the entire public procurement and the scope of the climate footprint of each procurement area. This is done with a point of departure in the best available calculation model for emissions both in Denmark and abroad – EXIOBASE. In the model, the data on emissions of CO_2 equivalents (CO_2eq) is, for the majority, based on 2011 data.

An analysis of the climate footprint can be more or less detailed, but in order to be able to measure the effect of specific measures in order to reduce the CO_2eq, more detailed and updated assessments are required, where a distinction can be made between green procurement and non-green procurement[4]). That is not possible with this calculation.

The calculation method further implies that the larger the total procurement is in a sector, the larger the climate footprint. This must be taken into account for an assessment of where the biggest gains of efforts would occur.

The total climate footprint of public procurement

The climate footprint of public procurement for 2019 has been assessed at DKK 12 million tons of CO_2eq. On average, an industry or a sector has a larger climate footprint, the larger the total procurement in the area is. The largest climate footprint comes from 'Construction', while procurement of different types of goods as well as 'Energy and Utilities' constitute the second and third largest climate footprints. Of the total climate footprint, about 1/3 of the emissions occur in Denmark, while 2/3 occur abroad.

The climate footprint relates to procurement – not all public activity.

The climate footprint calculations in this analysis relate solely to *procurement* as a subset of all activities in the public sector[5]). Procurement should be interpreted as the procurement of goods and services carried out by public institutions[6]). The public sector procured for approx. DKK 184.6 billion in 2019. With DKK 93.6 billion, municipal procurement constitutes the largest share (almost 51 per cent) of public procurement, while government and regional procurement constitutes DKK 45.9 billion and DKK 45.1 billion, respectively.

The data basis for public procurement is predominantly invoice data at the aggregate level, which has been supplied to NIRAS by the Danish Regions, the Municipal & State Procurement Service (Staten og Kommunernes Indkøbsservice , SKI) and the Danish Agency for Public Finance and Management. To ensure the most correct data basis, a number of delimitations have been made in, and additions to the data basis[7]).

1) See CONCITO and the Danish Chamber of Commerce.
2) The climate footprint of procurement refers to CO_2 equivalents emitted as a consequence of a product or service being manufactured, transported and ultimately consumed, as a result of a procurement made by the public sector in 2019.
3) See Appendix 1 for a description of public procurement and procurement categories.
4) The present calculation is partly based on industry emissions from 2011, which means that the emission factor for some industries may be overestimated.
5) In other calculations an approach is often seen, which uncovers the climate footprint associated with all the operator's activities – see for example the North Denmark Region.
6) See Appendix 1 for a description of the data basis for calculating the climate footprint of public procurement.
7) See Appendix 1.

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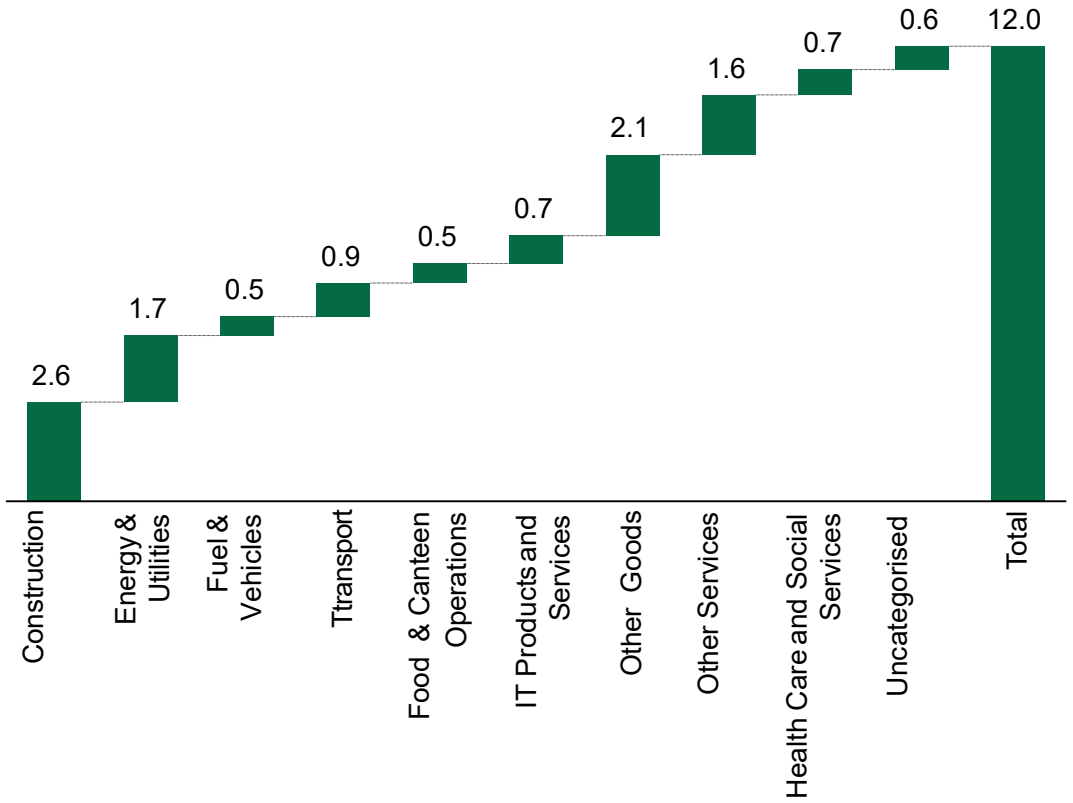
The total climate footprint of public procurement in Denmark in 2019 amounted to DKK 12 million tons of CO_2 equivalents

Figure 1: The climate footprint of public procurement according to procurement area (2019; million tons of CO2eq.)

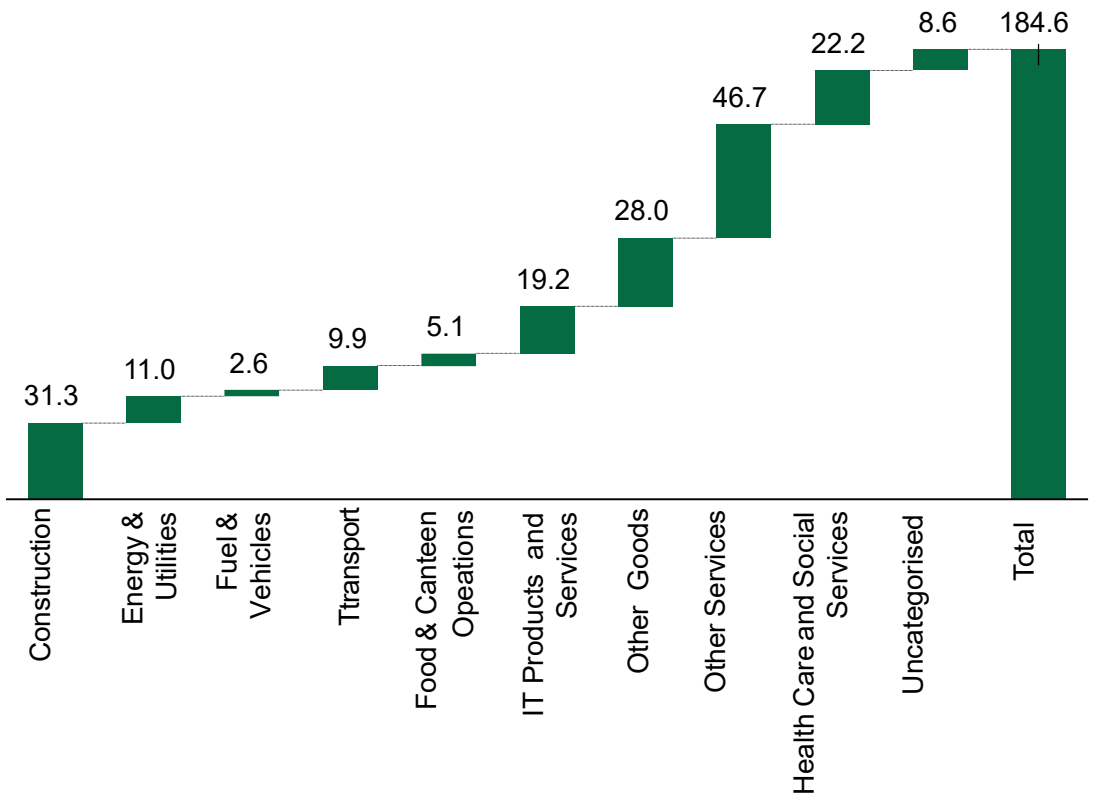


Results

- Figure 1 shows the calculated climate footprint of public procurement in Denmark in 2019 according to nine different procurement areas. Each procurement area summarises the climate footprint of public procurement from a number of different industries and is explained further from page 15 and onwards.
- The climate footprint is assessed at 12 million tons of CO_2eq.
- The largest climate footprint comes from the procurement area 'Construction', which contains both new construction and new facilities as well as repair and maintenance of existing buildings and facilities.
- The second and fourth largest climate footprint comes from two procurement areas: 'Other Goods' and 'Other Services' covering the procurement of goods and services from a vast number of different industries.
- The third largest climate footprint comes from the procurement area 'Energy & Utilities', which covers the public consumption of electricity, district heating and natural gas as well as other utilities such as water and waste management.
- In addition, the following will describe how the climate footprint is distributed between emissions emitted in Denmark and emissions emitted abroad, the distribution between the different sectors (government, region and municipality), the monetary distributions of the public procurements as well as detailed descriptions of the procurement under each of the nine procurement areas.

In 2019, the public sector procured for DKK 184.6 billion

Figure 2: The total public procurement according to the procurement area (2019; DKK billion)



Results

- Figure 2 shows the total public procurement in 2019 according to the nine different procurement areas. Each procurement area summarises public procurement from a number of different industries, and is explained further from page 15 and onwards.
- In 2019, the public sectors procured for DKK 184.6 billion.
- “Public procurement” refers to the total amount, which the government (incl. the self-governing sector), regions and municipalities procured for, and for which an invoice basis is available[1]).
- The largest procurement area is ‘Other Services’, under which procurement for DKK 46.7 billion is compiled. 'Other Services' covers a wide range of industries, from the legal profession and other types of consulting services, to the cleaning industry and other forms of performing service industries. However, the area does not cover all services, which the public sector procures, as e.g. services related to health are compiled in a separate procurement area.
- The second largest procurement area is 'Construction’, under which both the procurement of new construction and new facilities as well as the procurement of repair and maintenance services of existing buildings and facilities are compiled.

 1) See Appendix 1 for a description of the data basis for the calculation of the climate foot print of public procurement.

The calculation is based on the EE-MRIO table EXIOBASE

The model behind the calculation

The climate footprint of public procurement has been calculated using the calculation model EXIOBASE, which is an Environmentally Extended Multi-Regional Input/Output table (EE-MRIO table) [1]. Among other things, EXIOBASE was selected as the model also includes the emissions abroad, and because extensive use was made of additional statistical data in the model for further processing of the underlying MRIO tables into an actual calculation model, from which the results can be linked directly to procurement data. The calculation model embraces the value chain for procurement, right from extraction of raw materials to the disposal of the product:

For example, when the public sector procures furniture, some of the materials that are part of the production originate from timber felling or textile production abroad. The need for materials and goods from abroad for the furniture industry in Denmark is included in EXIOBASE as an import for the Danish furniture industry. Imports and its climate footprint are included in EXIOBASE, as it embraces the entire global value chain for each industry. Disposal is part of the climate footprint through public consumption of waste management services.

Indirect link to the 70 per cent target

A broad majority in the Danish Parliament has an objective that Denmark must reduce its total CO_2eq emissions by 70 per cent prior to 2030 (cf. 1990 level). The calculation of the climate footprint of public procurement in this calculation is not directly translatable to the 70 per cent target. This is due to the fact that the 70 per cent target is based on the UN's assessment principles, which alone relate to the climate footprint as a result of production in Denmark. This analysis concerns the climate footprint in both Denmark and abroad as a result of consumption *in* Denmark[2]. The extended scope has been a separate priority in the analysis because it enables the calculation of the emissions of consumption through the entire procurement value chain.

However, the calculation still concerns emissions of CO_2eq, the reason for which findings in the calculation regarding Danish emissions provide new information that can be used to support climate policy priorities and thereby support the green transition[3].

Collaboration constellation in the project

The analysis of the climate footprint of public procurement in 2019 was carried out by NIRAS A/S in collaboration with the Danish Agency for Public Finance and Management and The Ministry of Climate, Energy and Utilities, the Ministry of the Environment and Food and the Ministry of Industry, Business and Financial Affairs under the auspices of the work with the Government's strategy for green public procurement.

In addition, a discussion group consisting of of experts from the Danish Council on Climate Change, CONCITO, the University of Southern Denmark, the Danish Economic Councils, Statistics Denmark and Aalborg University assisted with feedback for the analysis.

1) The principles of the calculation model are explained in Appendix 2.
2) Appendix 3 contains an explanation of the link between the climate footprint of public procurement and the Government's 70 per cent reduction target.
3) The domestic emissions, which are included in the calculation, however, cover a smaller emission than the corresponding emission in the 70 per cent target, because the calculation is based on consumption data – and part of the Danish production (which is included in the 70 per cent target), is located abroad

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The calculation model has several limitations, e.g. that it is not possible to see the effect of shifting from conventional to greener procurement

Limitations of the calculation model and calculation basis

There are a number of limitations in the applicability of the results due to a combination of limitations in the existing calculation models on the market, and the available quality of invoice data. These can be gradually solved by continuing to work with the calculation basis and model. At this time, the limitations and the consequences are as follows.

- The calculation model's level of detail is according to industry and does not allow differentiation between individual emissions from different product groups supplied by an industry. Therefore, all products from a given industry are included in the calculation with the same average emission of CO_2eq per Danish procurement Krone. This means that a lower emission is calculated from a cheap product than from an expensive product, independently of the product's other characteristics. This means that the larger a procurement a sector or institution has, the larger the climate footprint. Based on an average consideration the calculation is accurate at the aggregate industry level, while at the product level, it is more uncertain.
- The limitation means that the model cannot take into account an institution's shift in procurement from a conventional to a greener product within the same industry. A shift will only take effect once the volume of sales of the green variants reaches an extent that prompts the industry's total climate footprint to change. However, in this case, the lower average emissions per procurement Krone will still apply to the entire industry and not just to the green products. A shift in procurement across industries, e.g. from air to train travel, however, is directly reflected in the calculation.
- For the majority, the calculation model's data on emissions of CO_2eq is based on data from 2011, as this is currently the latest available data in EXIOBASE[1)]. The exception from this is the direct energy-related procurement (electricity, district heating, natural gas and fuels), which are calculated separately based on emission coefficients for 2019[2)]. The limitation means that the emission factor for some industries may be overestimated[3)].
- The Danish Agency for Public Finance and Management does not have invoice data for the entire self-governing sector, for which reason the total procurement volume has been extrapolated based on the known portion of the procurement volume. This results in some uncertainty about a delimited portion of data and thus also in the climate footprint calculation itself[4)].

Continuous improvements enable greater usability

The mentioned limitations will become possible to reduce any repetitions of the calculation in future. Partly because, most likely, there will be a development in the market for calculation models for this purpose, and partly because the quality of the data basis is continuously improved. For example, there is a need to improve the model's data basis with newer emission coefficients and more detailed I/O tables and with more detailed invoice data. Such measures will increase the applications of repeated calculations including, for example, the possibility to follow up on the effect of a green initiative.

Despite the listed limitations, the calculation model has enabled the first official climate footprint calculation and created a basis to assess the overall picture and the proportions of emissions from procurement across the public sector.

1) An update with 2016 data is expected early 2021.
2) See Appendix 4 for a description of the method used to calculate the climate footprint of electricity, heat and fuel consumption.
3) See Appendix 5 for how this was sought compensated.
4) See Appendix 1 for elaboration.

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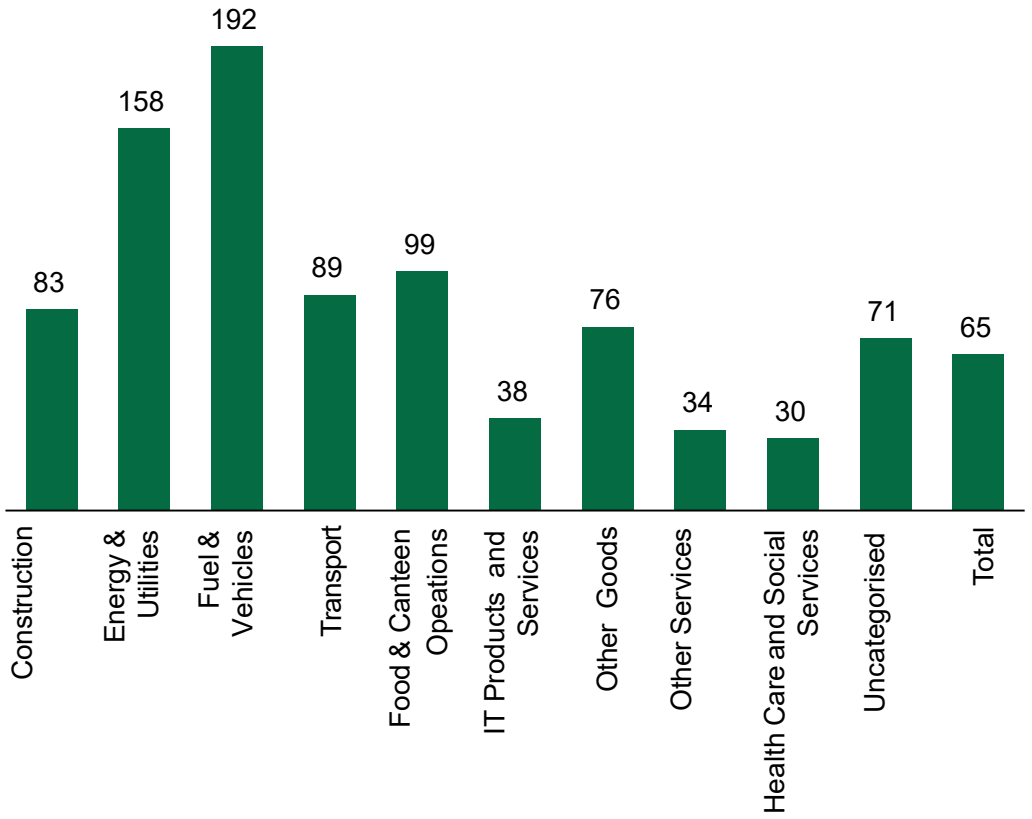
Total results

There are big differences in how much emission per procurement Krone a procurement causes

Figure 3: Average content of CO_2 equivalents per procurement Krone according to procurement area (2019; grams of CO_2eq per procurement Krone)

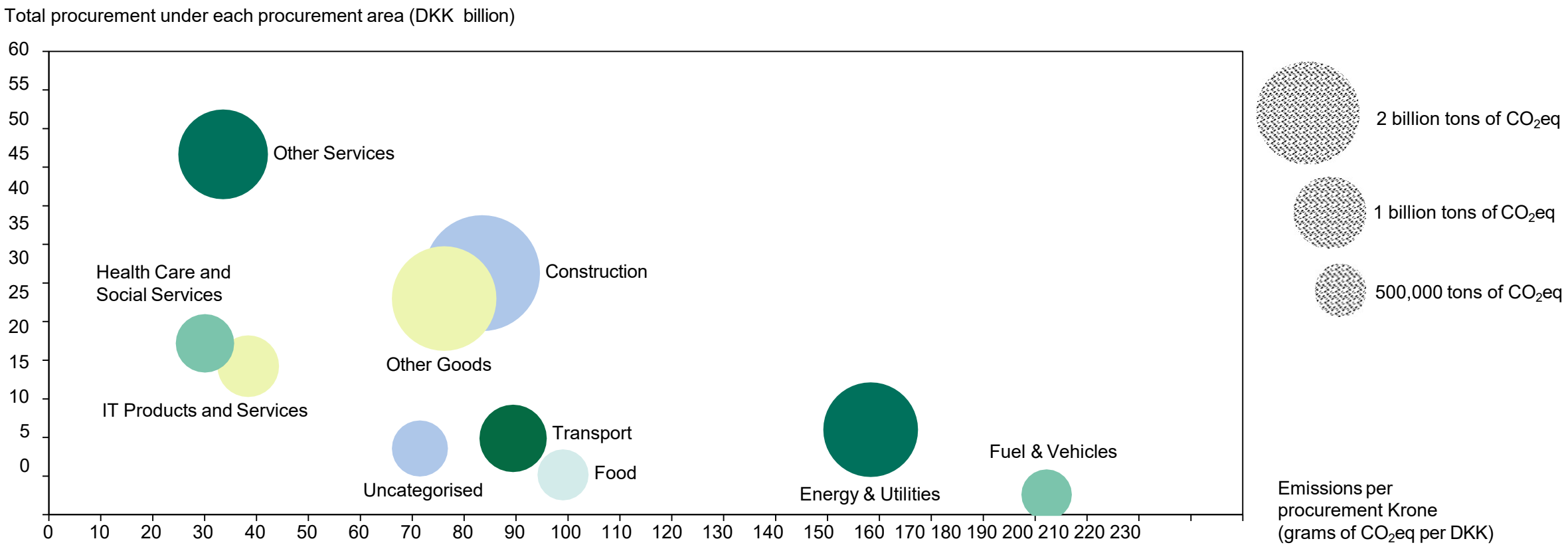


Results

- Figure 3 shows the average content of CO_2 equivalents (CO_2eq) per procurement Krone within each of the nine procurement areas. For the 'Uncategorised' procurement, a weighted average factor was applied based on other procurement.
- The procurement areas ‘Fuel & Vehicles’ and ‘Energy & Utilities have the highest average emissions per procurement Krone. This is due to the fact that these procurement areas cover either the direct procurement and the combustion of fossil fuels (natural gas and petrol/diesel/aviation fuel), or procurement from industries, who carry out this combustion (the electricity and district heating industries). The average emission per procurement Krone is, therefore, correspondingly high.
- The two procurement areas, which primarily consist of services; ‘Health Care and Social Services’ and ‘Other Services’, have the lowest average emissions per procurement Krone. This is due to the fact that the resource consumption for the supply of services mainly consists of wage Kroner, which does not entail emissions of CO_2eq. The emissions per procurement Krone contained in the procurement of services instead come from the materials (e.g. paper and computer) as well as from the energy consumption related to electricity, heat and transport, which suppliers of services buy from other industries.

Calculated CO_2eq emissions for each of the nine procurement areas as well as uncategorised procurement

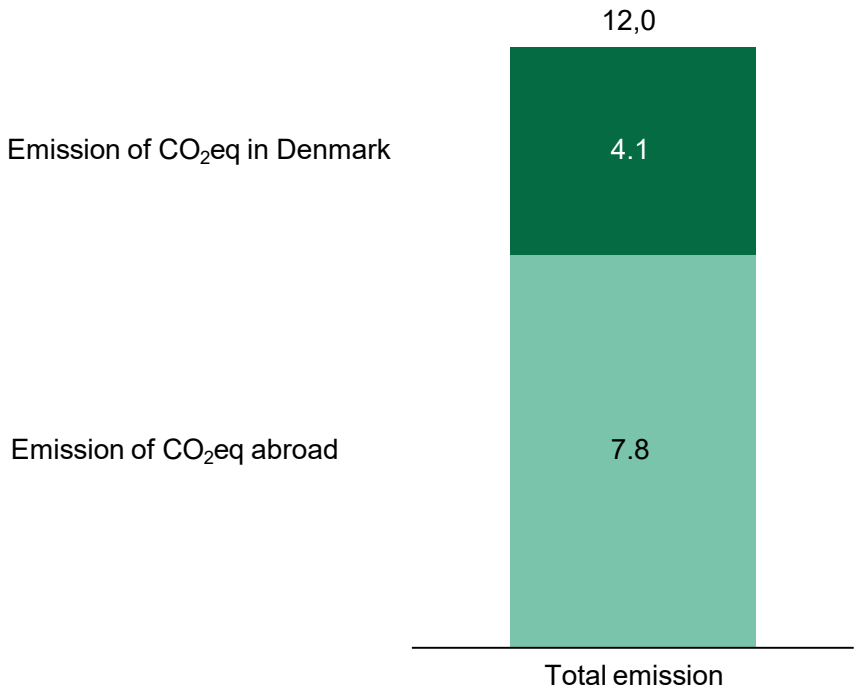
Figure 4: Total CO_2eq emissions for each procurement area (2019; tons of CO2eq.)



The majority of the climate footprint of public procurement is emitted abroad.

Only 1/3 is emitted within Denmark's borders

Figure 5: The climate footprint of public procurement in Denmark and abroad (2019; million tons of CO2eq.)

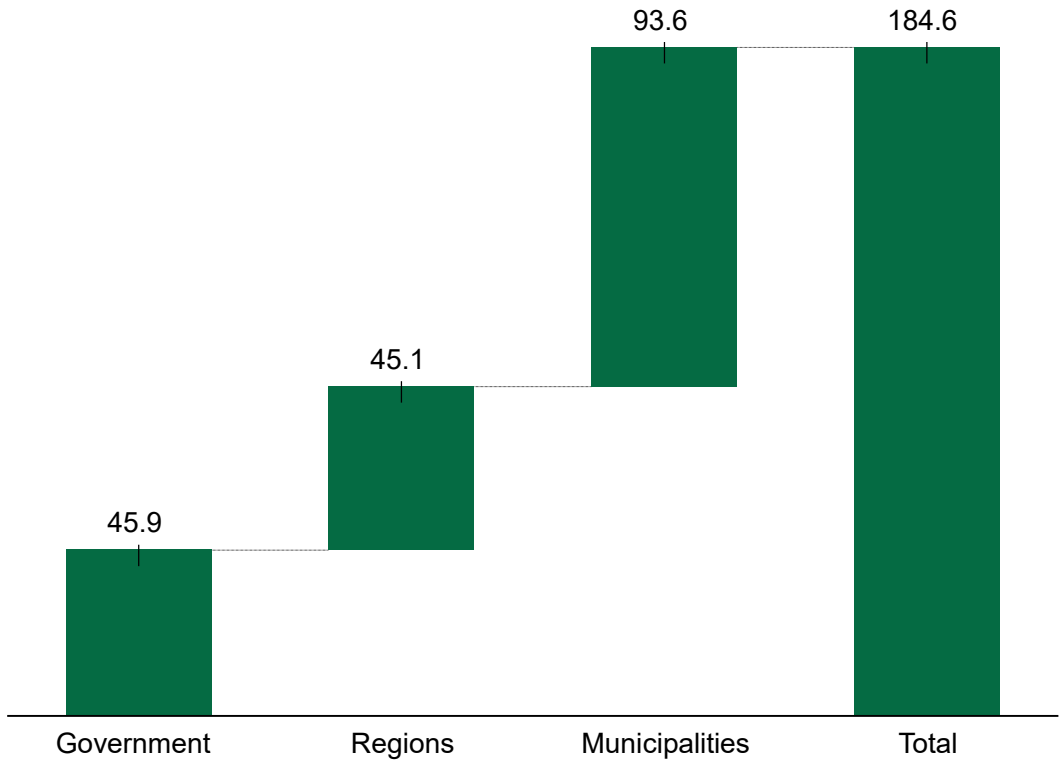


Results

- Figure 5 shows the distribution of the climate footprint of public procurement in 2019 between Denmark and abroad.
- Of the total climate footprint about 1/3 of emissions occur in Denmark, while 2/3 occur in the countries from which Denmark imports raw materials, semi-finished products and finished goods and services
- There are big differences from industry to industry, as to how big a portion of emissions occurs through the value chain in Denmark and abroad, respectively. The majority of emissions from energy and fuel consumption occur directly in Denmark. Conversely, only a small portion of emissions from the manufacture of machines, appliances, electronics etc., occurs in Denmark.
- The majority of emissions from the manufacture of goods originates from the initial extraction and production of metals and other raw materials, which predominantly occurs abroad. Although the majority of the value added occurs in Denmark, where metals and other raw materials are further processed and semi-finished products are assembled, the working hours and value added in Denmark only result in limited additional emissions.
- The emissions that are added in Denmark, are primarily from energy consumption for further processing and from the emissions contained in the goods and services, which the industry draws on from other industries.

Municipalities account for just over half of the total public procurement, while the government and the regions account for almost a quarter each

Figure 6: The public sector's total procurement according to the government, regions and municipalities (2019; DKK billion)

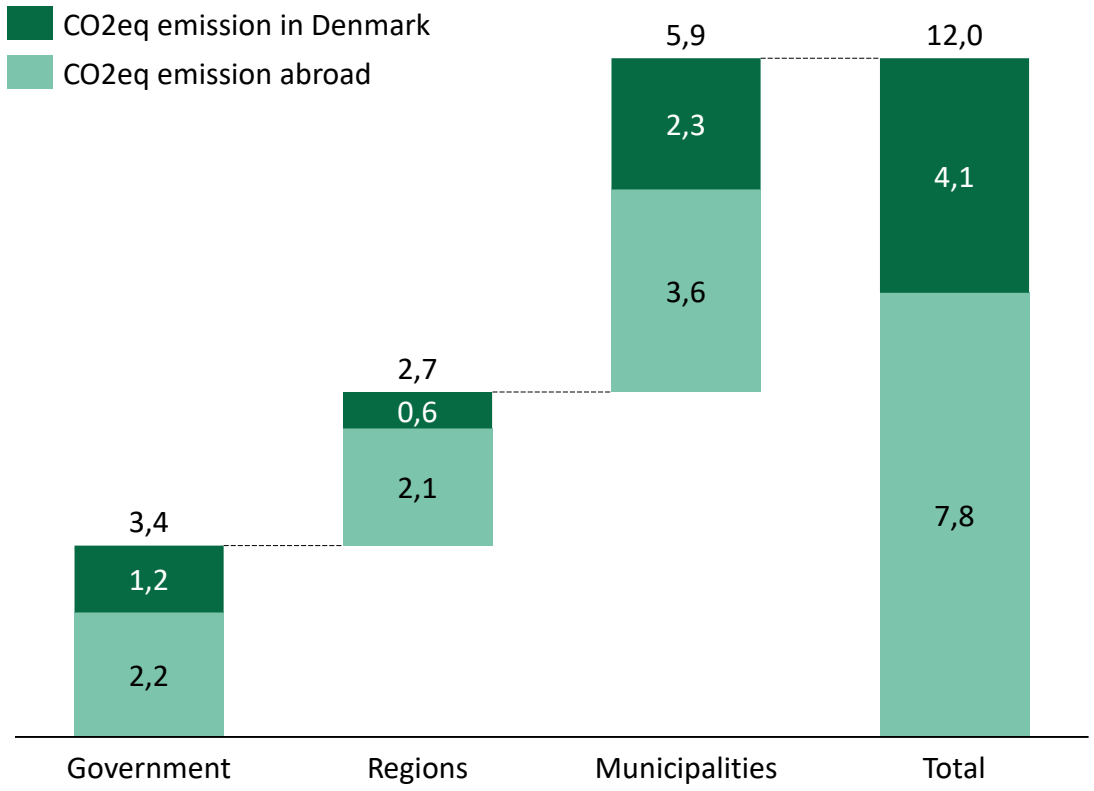


Results

- Figure 6 shows the total public procurement in 2019, based on the government's, the regions' and the municipalities' total invoice basis.
- Overall, the municipalities account for just over half of the total public procurement, while the government and the regions account for barely a quarter each. This method means, that the larger a procurement a sector or institution has, the larger the climate footprint of each sector/institution. This means that municipalities also have the largest climate footprint.
- The procurement that is carried out within each sector, reflects the sector's core tasks. For example, the municipalities' procurement ranges from the procurement of spots in social housing to mentoring courses and food in day-care centres and specially adapted prostheses.
- The difference between the public procurement based on invoice data (DKK 184.6 billion) and the public procurement based on the national accounts (approximately DKK 380 billion) is described in Appendix 1, but is made up of items such as VAT, internal payments, procurement from public companies and rental expenses.

Differences in the distribution of emission in Denmark and abroad amonngst sectors, are due to differences in the procurement of energy and fuel[1)]

Figure 7: The climate footprint in Denmark and abroad of the government's, the regions' and the municipalities' procurement (2019; 1,000 tons of CO2eq.)



Results

- Figure 7 shows the distribution of the climate footprint of the government's, the regions' and the municipalities' procurement, respectively, in 2019 between Denmark and abroad.
- As the municipalities have the largest procurement volume, the municipalities' procurement is responsible for just under half of the climate footprint, which corresponds to their monetary share of the procurement volume. The government and the regions have slightly higher and slightly lower total climate footprints, respectively, than their proportionate shares of the total procurement volume.
- For all three sectors the majority of the climate footprint that was caused by their procurement was emitted abroad.
- However, there are differences between the sectors, as to the share of the climate footprint that is emitted in Denmark and abroad. This is due to underlying differences as to how big a share of the total procurement volume goes to the procurement of energy and fuels. Partly, the emissions occur from energy and fuels primarily in Denmark, and partly, energy and fuels have the highest content of emissions per procurement Krone. Since 5.9 per cent of total municipal procurement goes to energy and fuels, a larger portion of their footprint is, therefore, emitted in Denmark. Conversely, the regions have a relatively smaller share of their footprint in Denmark, as energy and fuel make up only 1.5 per cent of their procurement volume. The government is in the middle with 3.5 per cent.

 1) No reference is made to differences in absolute consumption, but rather to differences as to how big a share the costs of energy and fuels make up of the total procurement volume.

Results for procurement areas

Public procurement from more than 80 different industries are compiled in nine procurement areas (1/2)

The total public procurement is compiled in nine procurement areas

All procurement that is included in the analysis basis has been matched with the EXIOBASE category, which covers the industry that has supplied each product or service. The public procurement covers a wide field, and in connection with the analysis work, procurement from more than 80 different industries has been identified.

For the sake of clarity in the reporting, procurement from these 80+ industries has been compiled in nine overall procurement areas, which are described briefly below and reviewed on the following pages[1)].

Construction

Contains all invoices from contractors that the government has received in 2019. In addition, the area contains invoice data for direct procurement of raw materials for use in construction projects. This area covers anything from painting and building operations to paving and other heavy-duty construction tasks.

Energy & Utilities

Covers procurement of electricity, district heating, natural gas, water, heating oil and waste management.

Fuel & Vehicles

Covers procurement of fuels including fuels for aircraft and ships. In addition, procurement of vehicles as well as workshop services and other operating and maintenance costs are included. Leasing services are not included but are included under ‘Other Services’.

Transport

Covers all types of transport services, including air travel, ferry tickets, train tickets, moving services, ambulance services, car towing, shipping, public transport traffic, etc.

Food & Canteen Operations

Covers procurement of meals for employees in the public sector as well as catering at meetings. Also covers meals for patients as well as food in school canteens and day-care centres. In addition, this area includes restaurant and conference expenses where the invoice basis may, however, cover a mix of room rental, meals as well as accommodation[2)].

It should be noted that for certain canteens, the government pays a portion of the total cost of meals for employees, while the rest is self-payment. Here, the invoice basis does not include the portion, which employees pay directly to the supplier.

IT Products and Services

Includes both the procurement of IT-related products such as computers, servers, printers, telephones, software, etc., and IT-related services such as telecommunications and satellite connections as well as data processing and storage. Consulting services related to IT are also included in this procurement area.

1) Appendix 6 lists the industries in Statistics Denmark, which include each of the nine procurement areas and which indicate any simplified name that may have been used in the report to refer to the industry.

2) Where possible, this has been corrected. This is described in more detail in Appendix 5.

Public procurement from more than 80 different industries are compiled in nine procurement areas (2/2)

Other goods
This procurement area covers all goods, which are not included in the other procurement areas and hence represent a broad selection of goods from medical and hospital equipment, to toys and clothing, to office furniture and printer paper.

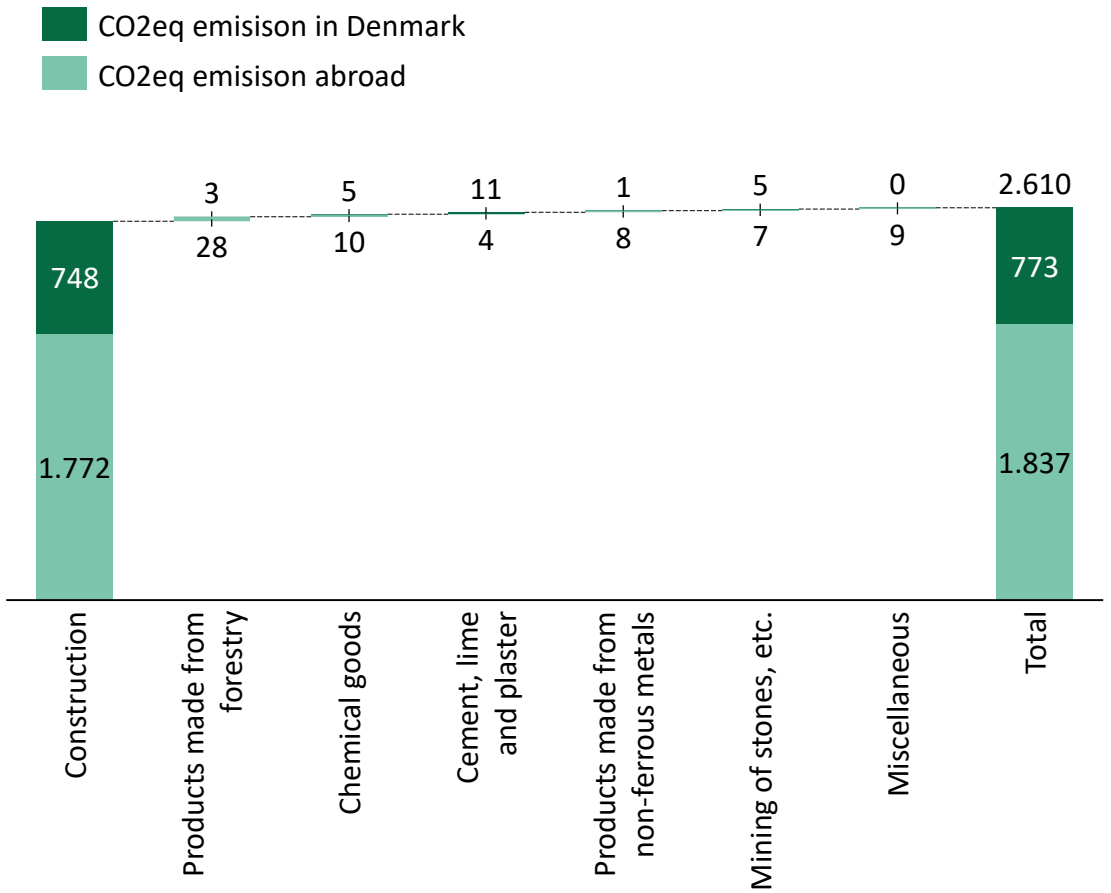
Other services
This procurement area contains all types of services, which are procured across the public sector, and which are not factored in under one of the other procurement areas. These include management consultants, temporary workers, instruction, consulting engineers, lawyers, advertising agencies, postal & shipping, cleaning, banking insurance and leasing services, facility management services, etc.

Health Care and Social Services
Covers a wide range of health-related services that regions or municipalities do not provide themselves, but procure from external operators, including expenses for social housing.

Uncategorised
The invoicing lines, which, either mechanically or after manual processing, could not be placed under a specific industry, and thus included under a procurement area, have been compiled under ‘Uncategorised'.

The emissions from 'Construction' come from procurement of contractor and trades services – both for new construction and maintenance

Figure 8: The distribution of CO_2eq emissions from Construction (2019; 1,000 tons of CO2eq.)



Results

- Figure 8 shows the distribution of CO_2eq emissions from the procurement area 'Construction'. The average CO_2eq content per procurement Krone is for this procurement area 83 grams of CO_2eq/DKK (see page 10)
- The majority of the emissions come from the construction industry, which covers all types of contractor and trades services[1)].
- In addition, the procurement area covers a number of smaller amounts of procurement of building materials directly from the manufacturing industries. However, this is of a very limited scope, as the government, municipalities and regions do not themselves employ and pay staff to carry out major construction work.
- A large portion of the resource consumption in the services, which the public sector procures from the construction industry consists of the paid service hours, and of design and engineering services in connection with these tasks. These paid hours only add limited additional emissions to the final emissions.
- The remainder of the resource consumption is made up of the materials, etc. included in the final delivery, and the CO_2eq content of procurement from the construction industry therefore consists primarily of the emissions from the relatively high energy consumption this industry itself has as well as in the emissions contained in the draw on building materials such as cement and iron, which the construction industry depends on.

1) It should be noted that the calculation of the climate footprint is based on the invoices received during the year, including on-account charges, and that there may be significant time differences between this and the actual completed construction work.

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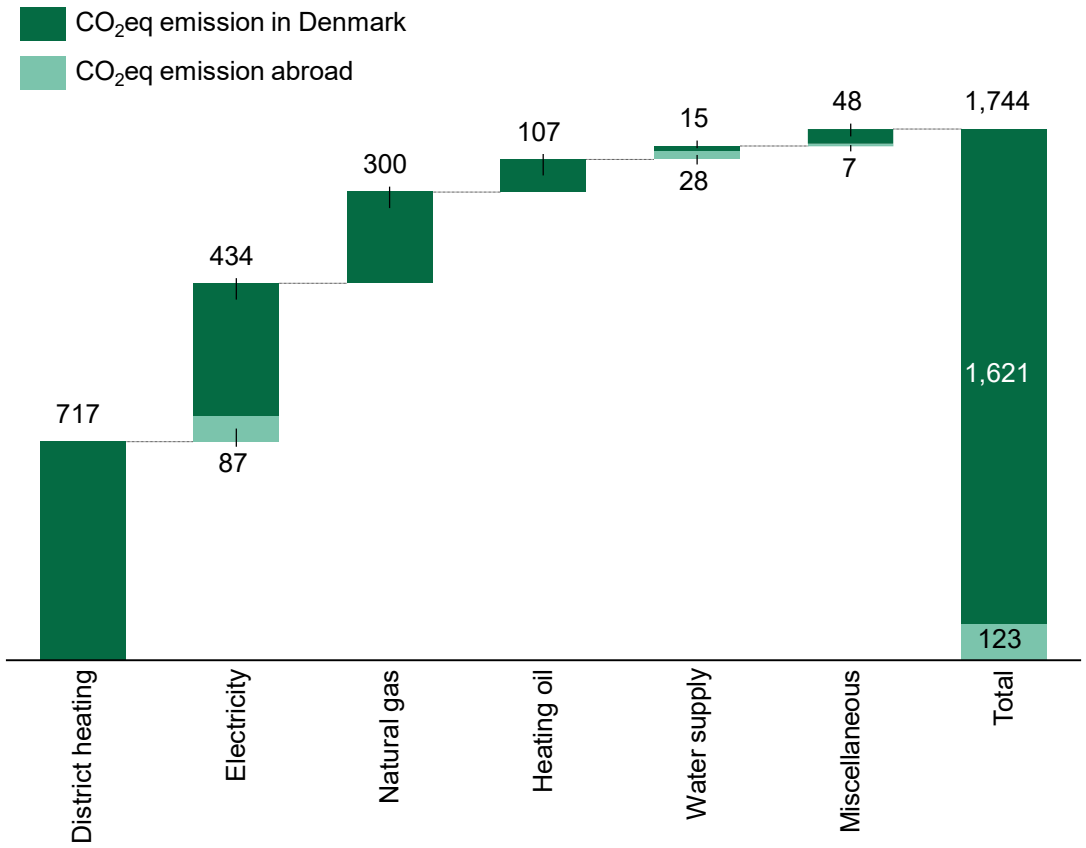
The emissions from ‘Energy & Utilities’ originate primarily from the consumption of district heating, electricity and natural gas

Figure 9: The distribution of CO_2eq emissions from Energy & Utilities (2019; 1,000 tons of CO2eq.)



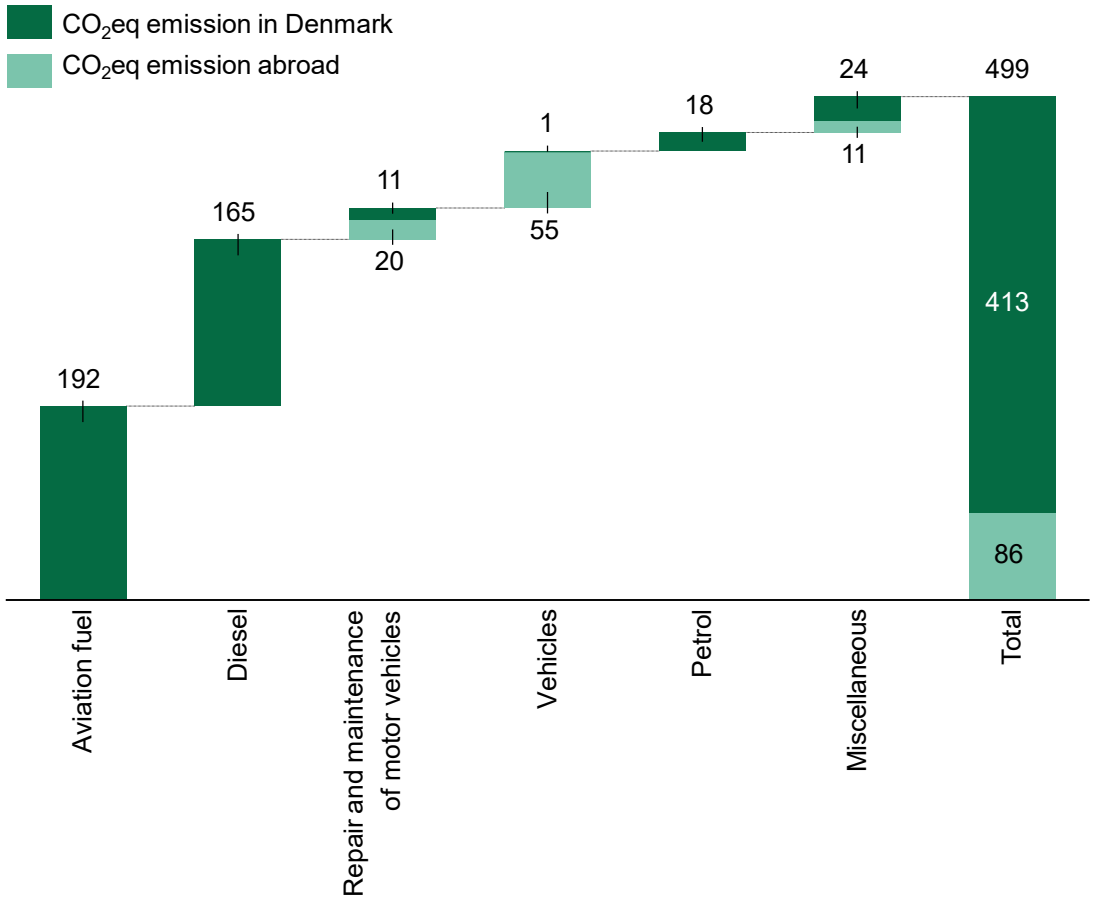
Results

- Figure 9 shows the distribution of CO_2eq emissions from the procurement area ‘Energy & Utilities’. The average CO_2eq content per procurement Krone for this procurement area is 158 grams of CO_2eq/DKK (see page 10).
- The procurement area ‘Energy & Utilities’ covers the public consumption of electricity, water and heat. The heat primarily consists of district heating and natural gas. In addition, other utilities such as waste management and wastewater treatment are covered.
- The emissions from district heating and electricity consumption as well as the consumption of natural gas make up the majority of the climate footprint of ‘Energy & Utilities'[1)].
- Natural gas consumption is one of the most emitting forms of energy, surpassed only by heating oil. Only about 20 per cent of heat demand is covered by natural gas boilers, but they account for 32 per cent of the climate footprint of heat.
- The emissions from district heating and natural gas take place exclusively in Denmark[2)], while the division of emissions from the electricity production between Denmark and abroad, respectively, are based on the net import of electricity.
- Emissions from especially district heating and electricity will be significantly reduced over the coming years, as the energy system is converted to a greener energy production. It will be possible to reduce the emissions from natural gas and heating oil through a shift to district heating or heat pumps, or greater use of biomass to bio/natural gas production.

1) The calculations of the climate footprint of district heating, electricity, and natural gas, and from heating oil, differ from the other industry-based calculations, as nodirect link has been made between invoice data and industry emission data from EXIOBASE. Instead, the total invoice amounts have been converted to quantity units, after which the climate footprint was calculated from the emission coefficients for each energy or fuel type. Appendix 4 describes these calculations.
2) Here, reference is made to fossil CO_2 emissions from the burning of fuels and waste, while biogenic CO_2 emissions from the burning of biomass are not included in the calculations. Emissions from extraction, refining and transport are included in the emission coefficients for natural gas and heating oil, but no assessment has been made as to how big a portion of these upstream emissions occurs abroad. For sources of emission coefficients for energy consumption, see Appendix 4.

The majority of emissions from ‘Fuel & Vehicles’ comes from the purchase of aviation fuel and diesel

Figure 10: The distribution of CO_2eq emissions from Fuel & Vehicles (2019; 1,000 tons of CO2 eq)



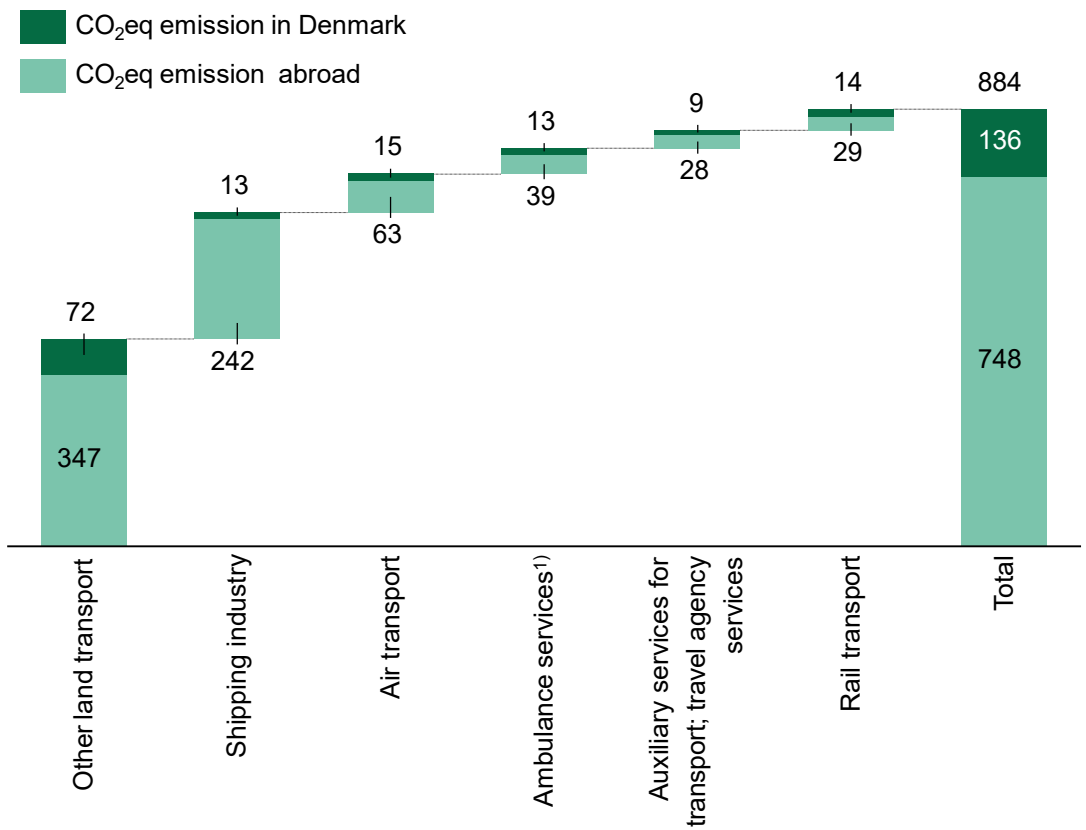
Results

- Figure 10 shows the distribution of CO_2eq emissions from the 'Fuel & Vehicles' procurement area. The average CO_2eq content per procurement Krone for this procurement area is 192 grams of CO_2eq DKK (see page 10).
- The procurement area covers the public sector's procurement of fuels for aircraft, land transport and shipping as well as the procurement, operation and maintenance of vehicles and other transport equipment.
- The climate footprint of aviation fuel and diesel constitutes the majority of emissions from the procurement area[1)].
- The category ‘Miscellaneous’covers procurement from the ‘Other Transport Equipment’ industry as well as marine gas oil for shipping.
- The climate footprint of the ‘Vehicles’ industry contains only the public sector’s direct procurement of vehicles. A very large portion of the car fleet is leased, among other things through KommuneLeasing, and invoice data for leasing services are included in the 'Other Business Services' industry under the procurement area 'Other Services’, regardless of which asset the lease concerns. It is estimated that the public sector leases about 6,000 vehicles, but that this only amounts to less than 5 per cent of the total leasing commitment with KommuneLeasing. The climate footprint of the production of vehicles is predominantly emitted abroad.

1) As for district heating, electricity and natural gas under the ‘Energy & Utilities’ procurement area, the climate footprint of fuels (aviation fuel, diesel and petrol) is calculated separately. Appendix 4 describes in more detail, how these calculations were made.

Emissions from ‘Transport’ include payments to public transit and from a large expense item to the chartering of cargo ships

Figure 11: The distribution of CO_2eq emissions from Transport (2019; 1,000 tons of CO2 eq)



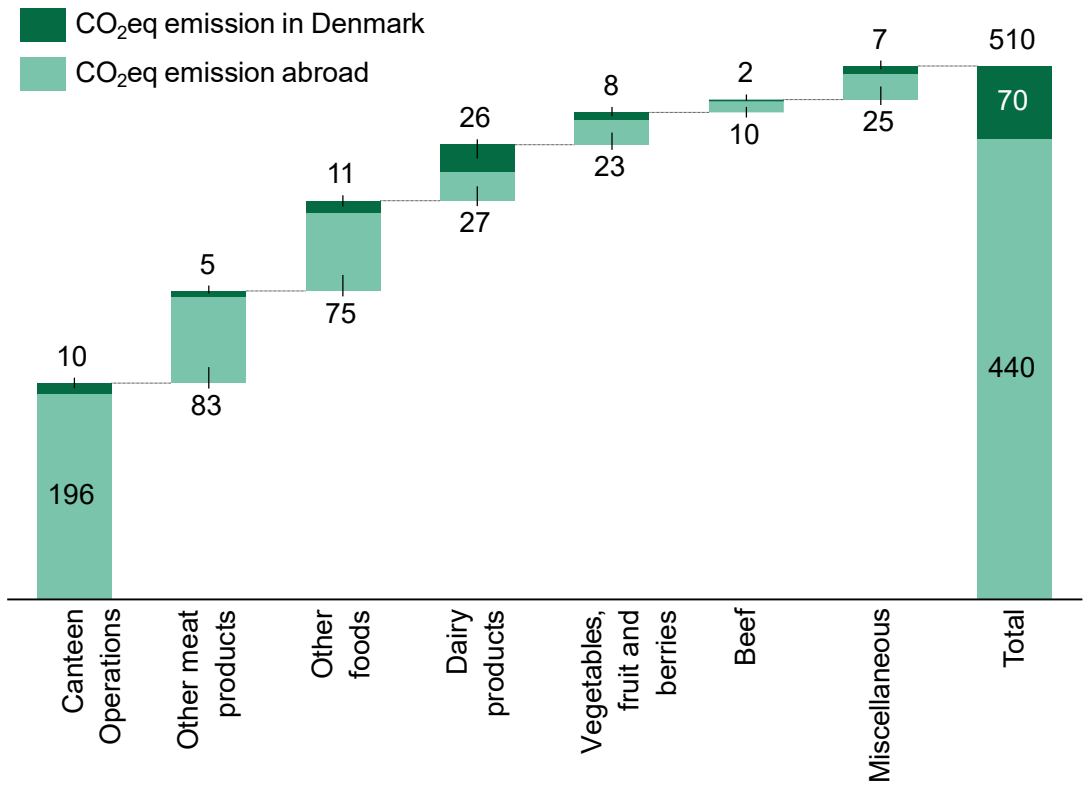
Results

- Figure 11 shows the distribution of CO_2eq emissions from the ‘Transport’ procurement area. The average CO_2eq content per procurement Krone is 89 grams of CO_2eq for this procurement area (see page 10).
- Procurement from the 'Other Land Transport' industry constitutes the largest item and primarily covers payments for public transit, for other bus and taxi services as well as invoice items for "driving", where there is no further specification.
- The climate footprint of the 'Shipping Industry' originates almost exclusively from a number of major expenditure items, which the government has for the chartering of cargo ships. Due to the shipping industry's large consumption of marine gas oil, procurement from this industry has a large CO_2eq content per procurement Krone, and the emissions primarily occur abroad.
- The third largest emission comes from procurement from the aviation industry. Here, the majority of the emissions also occur abroad and are primarily due to fuel consumption and to a lesser extent the production of the actual plane.

1) Emissions from Ambulance services are included under the procurement area Transport, although according to the Danish industry statistics , these belong under the procurement area Healthcare. This was selected in order to give a better representation of the total transport-related emissions {25 > from public procurement.

The emissions from ‘Food & Canteen Operations’ come from a mix of direct food procurement and indirect procurement through canteen operators

Figure 12: The distribution of CO_2eq emissions from Food[1] & Canteen Operations (2019; 1,000 tons of CO2eq.)



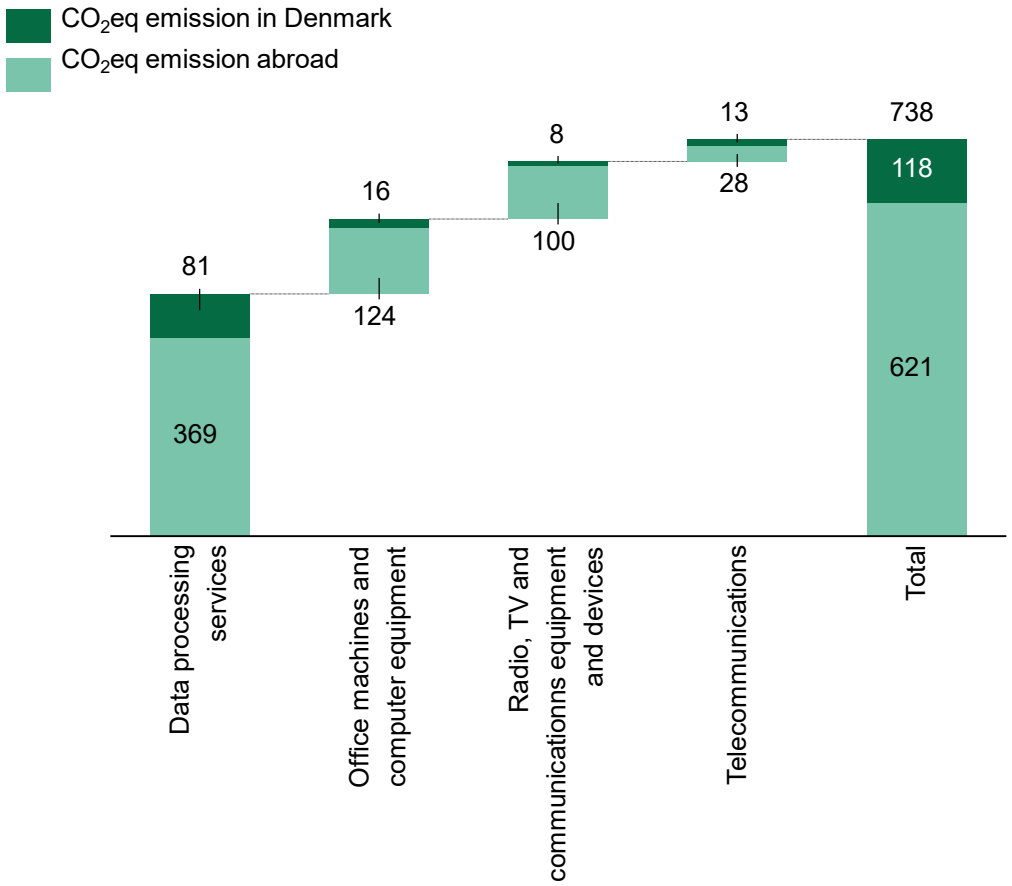
Results

- Figure 12 shows the distribution of CO_2eqemissions from the procurement area ‘Food & Canteen Operations’. The average CO_2eqcontent per procurement Krone is 99 grams for this procurement area CO_2eq/DKK
- The procurement area covers both the public sector's own direct procurement of food, which is subsequently prepared by its own staff as well as the procurement of canteen services from external operators.
- The largest category is 'Canteen Operations', where the invoice amounts thus also cover a large number of paid hours, which do not contain CO_2eq[2]. Invoices for restaurant visits and catering in connection with conferences and hotel accommodation are also included under this industry[3].
- In EXIOBASE, a subdivision has been made into different types of meat of the industry for the processing of meat and meat products. These are used where the invoice basis has allowed this[1].
- The category ‘Miscellaneous’ covers items such as pork, fish, poultry and cereal products.
- The fact that such a small share of the emissions from the food categories are emitted in Denmark, is due primarily to the fact that a large portion of these goods are imported. For example, more than 90% of 'Other meat products' and over 75% of 'Beef' is imported.

1) Differences in the level of detail in the invoice data basis mean that a large portion of the procurement cannot be specified on individual foods. It was therefore, to a large extent, necessary to match procurement with EXIOBASE categories such as "Other meat products "or" Other foods ", although a large portion of the invoice amounts actually may cover e.g., beef or vegetables. Therefore, the other food-specific categories do not contain the total emissions from that food type, but only emissions from the portion of the food concerned, which can be traced directly in the underlying invoice basis.
2) It should be noted that procurement of canteen services only covers the share covered by the public sector, and not the share the employees themselves pay to the canteen supplier.
3) See Appendix 5 for details.

The emissions from ‘IT Products and Services’ come from areas such as IT consulting and consultants, data centres, software and IT equipment

Figure 13: The distribution of CO_2eq emissions from IT Products and Services (2019; 1,000 tons of CO2eq.)

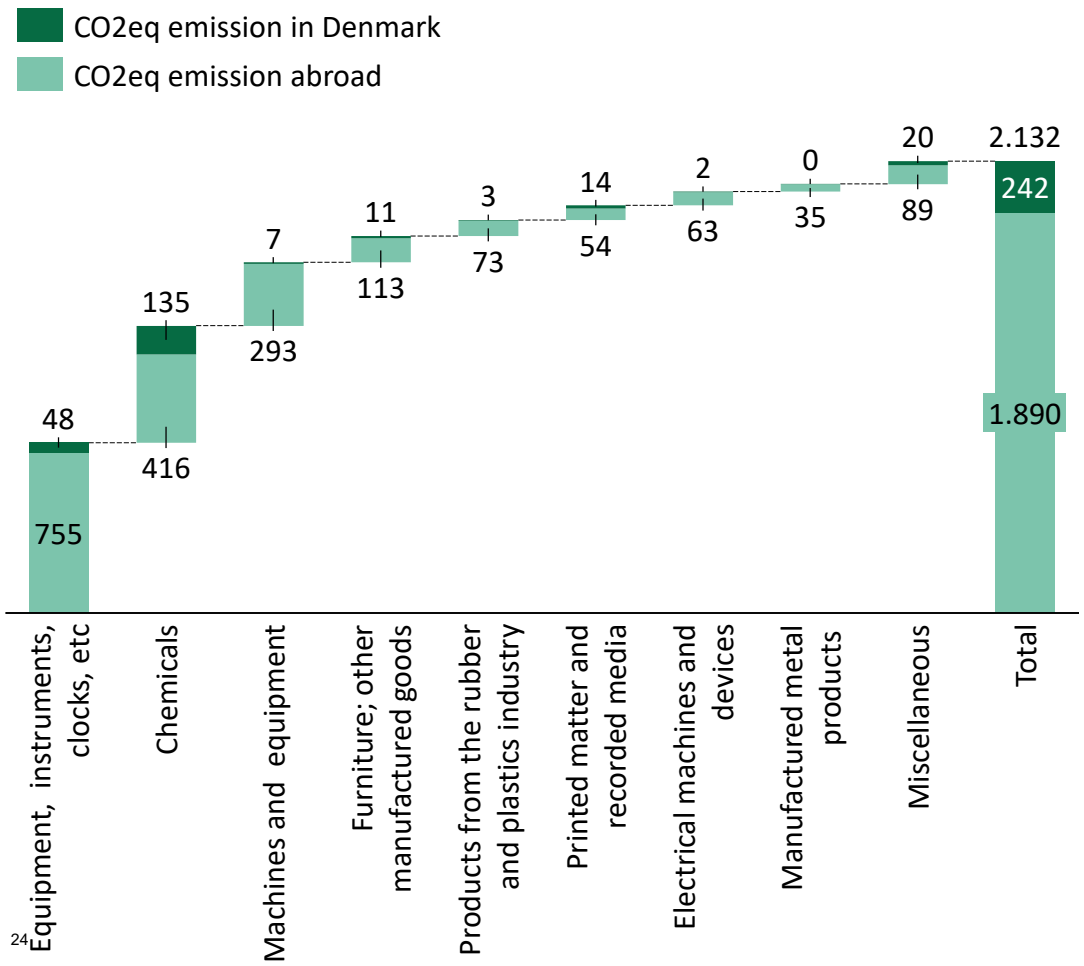


Results

- Figure 13 shows the distribution of CO_2eq emissions from the procurement area ‘IT Products and Services’. The average CO_2eq content per procurement Krone for this procurement area totals 38 grams of CO_2eq/DKK (see page 10).
- The procurement area covers the public sector's procurement of IT consulting and IT consulting hours, IT equipment and products, expenses or development, support and maintenance of software, and operating costs for IT and data services.
- The climate footprint of the industry for ‘Data Processing Services’ originates from areas such as IT consulting and from both consulting and performing IT consultants. In addition, it comes from the procurement of software and licenses as well as from development, support and maintenance costs for both software and hardware. Finally, data services such as hosting and storage are also included in this industry.

The emissions from 'Other Goods' mainly originate from the regions' procurement of medical equipment and medicinal products

Figure 14: The distribution of CO_2eq emissions from Other Goods (2019; 1,000 tons of CO2eq.)

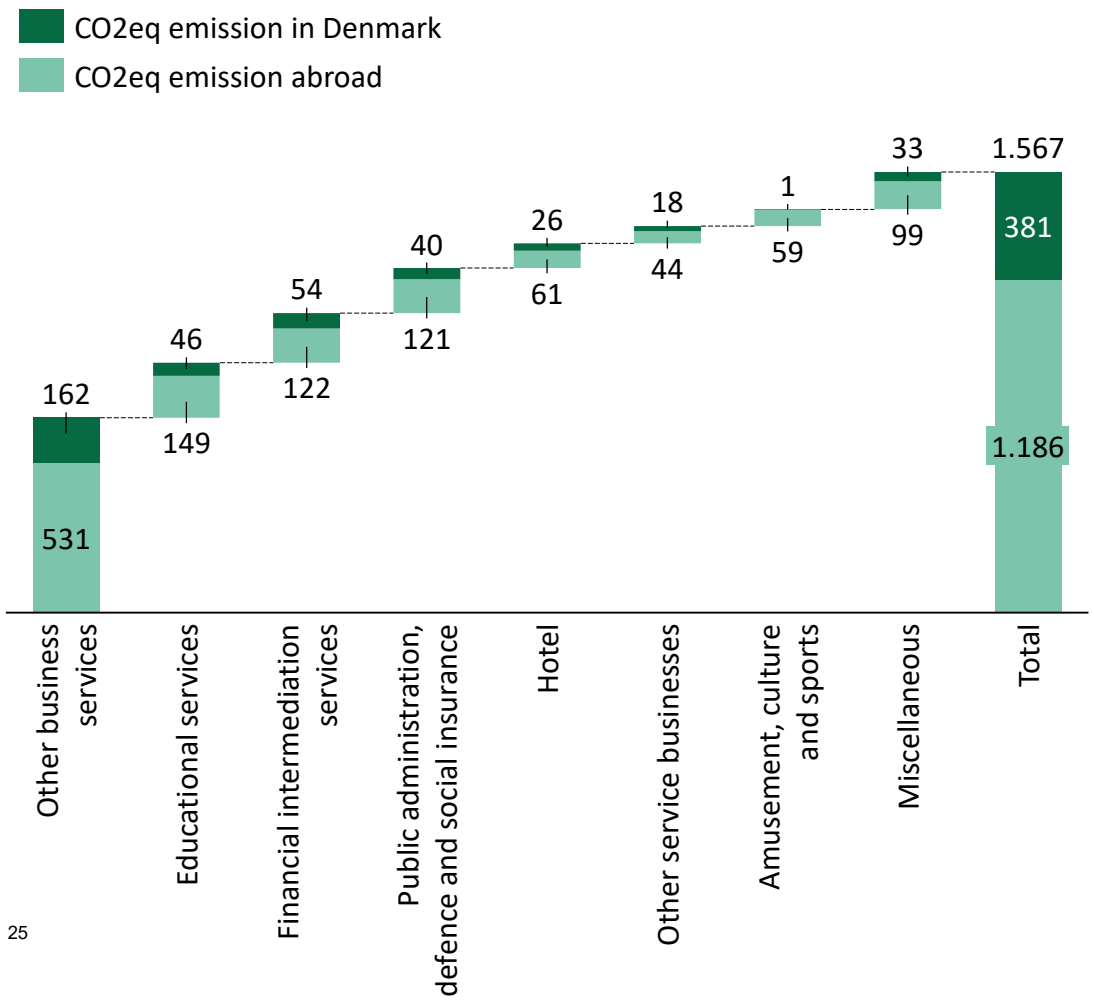


Results

- Figure 14 shows the distribution of CO_2eq emissions from the procurement area 'Other Goods'. The average CO_2eq content per procurement Krone is 76 grams of CO_2eq for this procurement area (see page 10).
- The procurement area covers the procurement of goods that are not included in the procurement areas for vehicles, food and IT products.
- Over half of the climate footprint of this procurement area comes from the regions' procurement, primarily of medical equipment and medicinal products.
- Procurement from the industry for 'Equipment, instruments, clocks, etc.' thus covers highly processed equipment and special equipment, which also includes medical equipment, measuring equipment, surgical implants, diagnostic products , etc. In addition, a large share of special equipment such as hearing aids and the like is also included.
- 'Chemicals' covers procurement from a relatively broadly defined industry for the chemical industry, which, for example, covers the pharmaceutical industry. The procurement, that has been matched with this industry, primarily consists of medicines and other medicinal products.
- 'Miscellaneous' covers items such as procurement of leather products, textiles and glass products.

The emissions from ‘Other Services’ primarily originate from a wide range of consulting services

Figure 15: The distribution of CO_2eq emissions from Other Services (2019; 1,000 tons of CO2eq.)

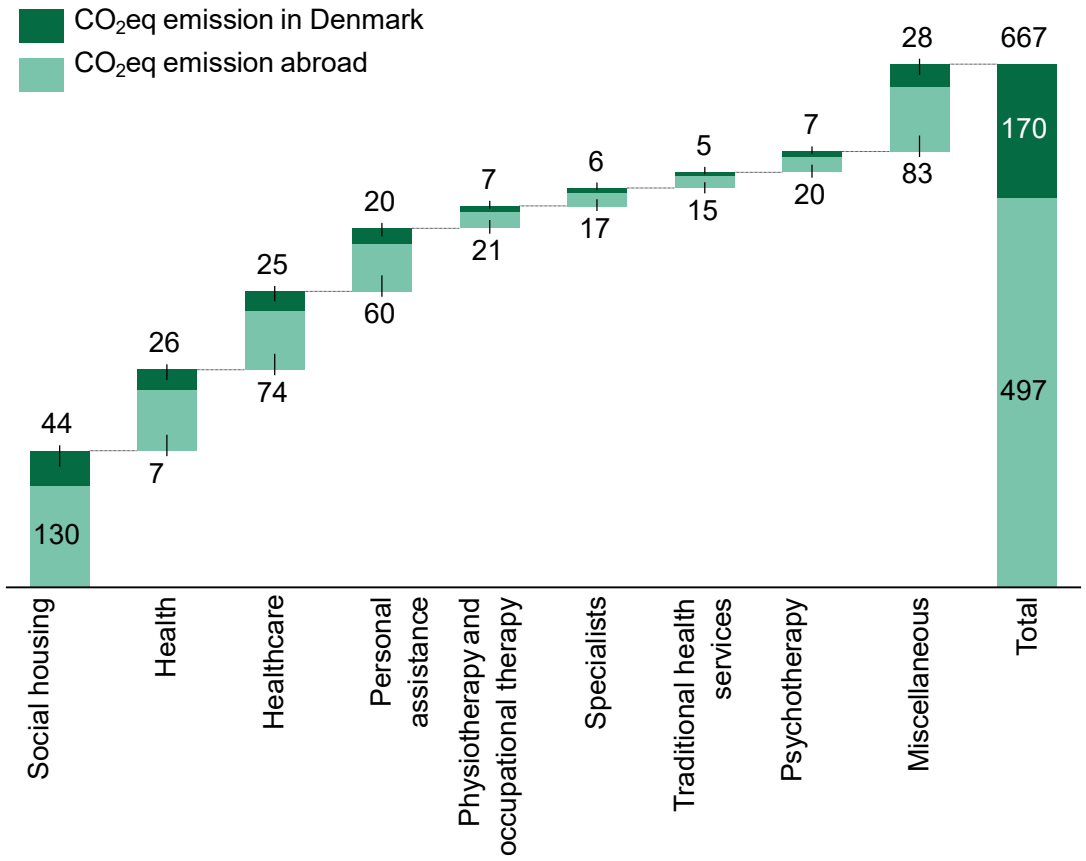


Results

- Figure 15 shows the distribution of CO_2eq emissions from the procurement area ‘Other Services’. The average CO_2eq content per procurement Krone for this procurement area is 34 grams of CO_2eq/DKK (see page 10).
- The procurement area covers the procurement of services that are not included in the procurement areas for ‘Construction’, ‘Transport’, ‘IT Products and Services’ or ‘Health Care and Social Services.
- Nearly half of the climate footprint of this procurement area originates from procurement from the ’Other business service’ industry, which broadly covers items such as consulting services from lawyers, architects, management consultants, accountants, consulting engineers, etc. In addition, the industry covers PR & advertisement, technical analyses, market surveys, recruitment, temp services as well as cleaning services and security services.
- The industry ‘Financial intermediation services’ covers items such as insurance and pension services, bank services as well as leasing services. The latter includes items such as the regions’ and the municipalities’ involvement with KommuneLeasing.
- The industry ‘Other service business’ covers items such as industrial laundry services, dry cleaners, hairdressers, undertakers and gyms.

The procurement area ‘Health Care and Social Services’ covers items such as payments to social housing

Figure 16: The distribution of CO_2eq emissions from Healthcare and Social Services (2019; 1,000 tons of CO2eq.)



Results

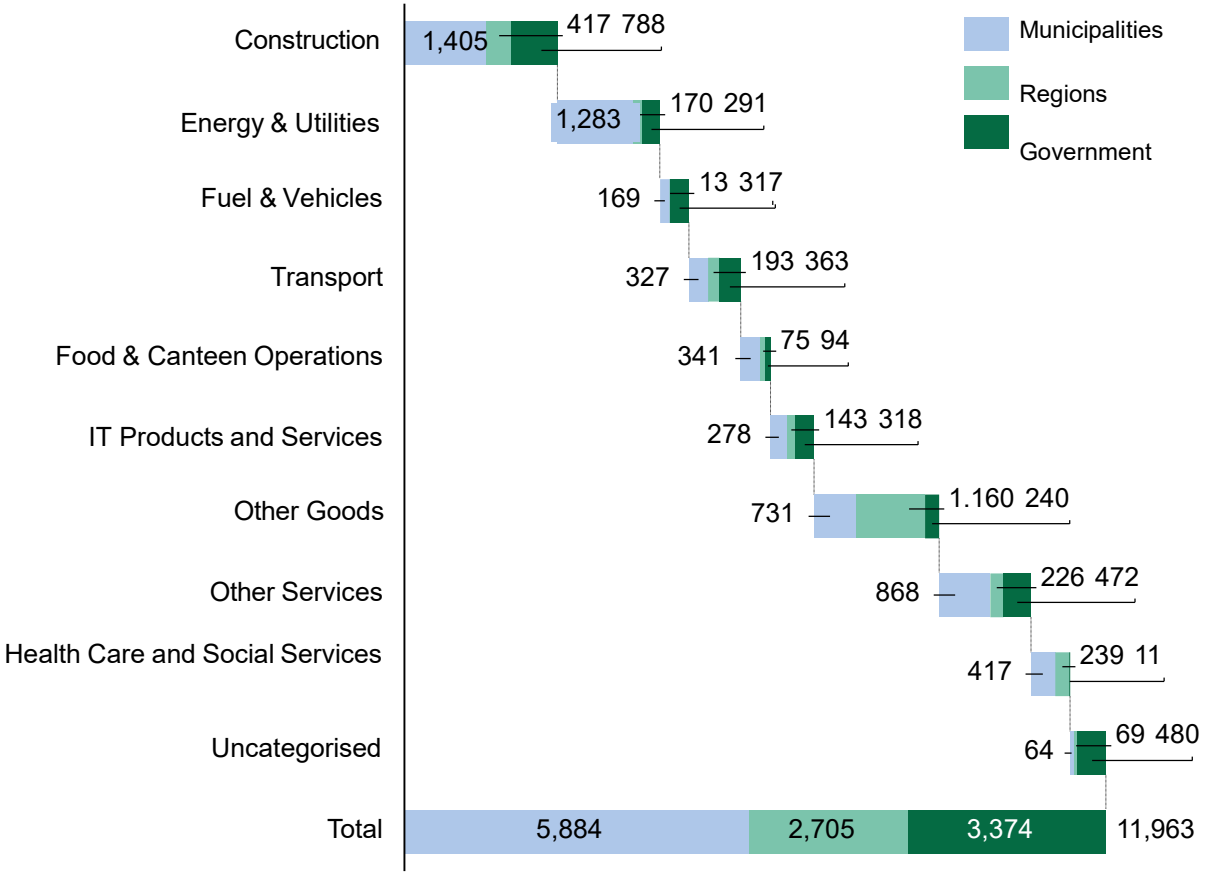
- Figure 16 shows CO_2eq emissions from the procurement area ‘Health Care and Social Services’. The CO_2eq content per procurement Krone for this procurement area is 30 grams of CO_2eq/DKK (see page 10).
- This procurement area only covers procurement from one industry; Healthcare and Social Services[1]. Instead, Figure 16 hence shows the climate footprint of procurement according to the classifications applied to divide the invoice basis into similar types of procurement[2].
- Since all procurement is made from the same industry, the calculation of the climate footprint of these goods and services is therefore also based on the same emission per procurement Krone. Differences in the total emissions for each of the classifications are therefore solely due to differences in the size of the amounts that were classified under each title.
- The classifications ‘Social housing’ and ‘Personal assistance’are primarily used in the municipalities’ invoice basis. In addition, the main part of emissions under the classification ‘Physiotherapy and occupational therapy’ and ‘Psychotherapy‘ as well as just over half of ‘Health’ originate from municipal data.
- The rest of the emissions under the classifications 'Physiotherapy and occupational therapy', 'Psychotherapy' and 'Health' as well as the majority of 'Health services', 'Specialists' and 'Traditional health care' originate from the regional invoice basis.

1) In principle, expenses for ambulance transport belong to this industry according to the Danish industry statistics, but is included under the procurement area 'Transport'.
2) See Appendix 1 for a detailed description of the processing of the regional and municipal data bases.

Sector-specific results

The task portfolio and procurement volume are decisive for the sectors' calculated climate footprint

Figure 17: The climate footprint of the government's, the regions' and the municipalities' procurement according to procurement areas (2019; 1,000 tons of CO2eq.)

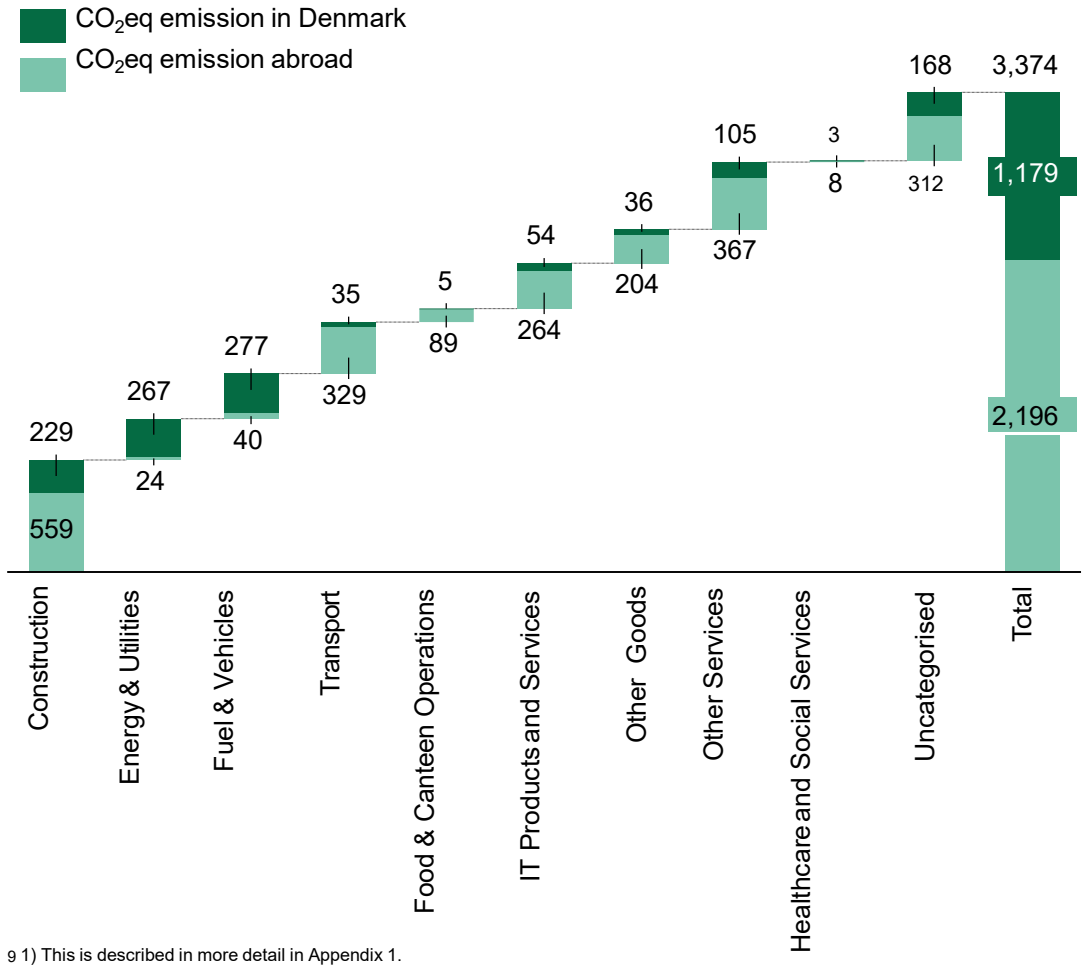


Results

- Figure 17 shows the distribution of the climate footprint of the government's, the regions' and the municipalities' procurement, respectively, across the nine procurement areas.
- The municipalities' share of the climate footprint corresponds to their share of the total procurement. The regions have a slightly lower share of the climate footprint than their proportionate share of the total procurement, while the government's share of the climate footprint is higher.
- The government has a proportionately larger share of the emissions from the procurement areas 'Fuel & Vehicles', 'Transport' and 'Other Services'. This is partly due to a large consumption of aviation fuel and the chartering of cargo ships. In addition, there is a relatively larger share of the Uncategorised procurement, which originates from the government's procurement.
- The regions have a proportionately larger share of the emissions from the procurement area 'Other Goods', which, among other things covers the hospital sector's procurement from the medical devices and pharmaceutical industries.
- The municipalities have a relatively larger share of the emissions from the procurement areas 'Energy & Utilities', which is due to the municipalities' large building stock compared to the two other sectors, and from 'Health Care and Social Services', which, among other things, is due to the municipalities' expenses for social housing.

The government has relatively large emissions from the procurement areas ‘Fuel & Vehicles’, ‘Transport’ and ‘Other Services’

Figure 18: The climate footprint in Denmark and abroad of government procurement (2019; 1,000 tons of CO2eq.)



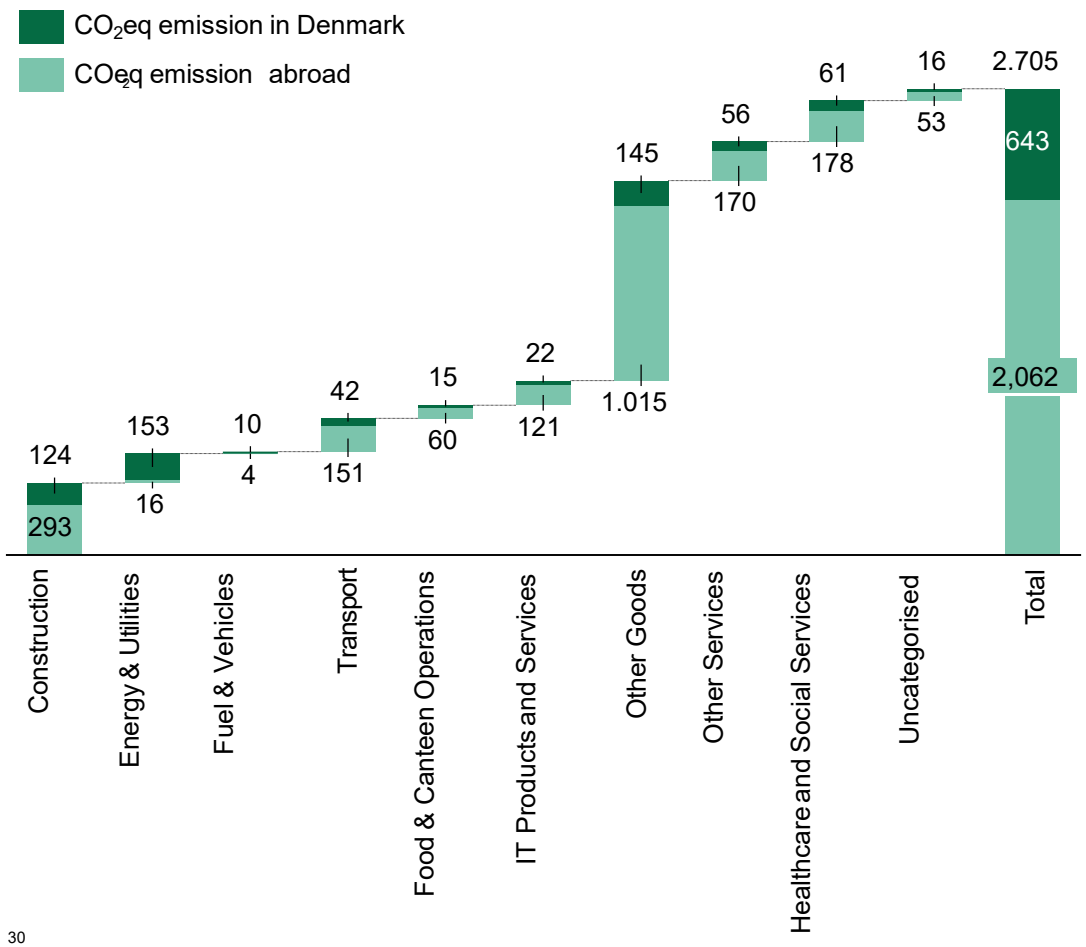
Results

- Figure 18 shows the distribution of the climate footprint of government procurement between Denmark and abroad. Of the total climate footprint about 35 per cent of emissions occur in Denmark, while about 65 per cent occur in the countries that Denmark imports raw materials, semi-finished products and finished goods and services from.
- Invoice data for government procurement includes the self-governing sector (the self-governing educational institutions).
- The procurement areas 'Construction’ and 'Other Services' constitute, both in terms of amount and climate footprint, the largest items.
- In addition, the procurement areas ‘Energy & Utilities, 'Fuel & Vehicles' and 'Transport' make up a proportionally large share of the climate footprint. For the latter two, the government accounts for a relatively larger share of the total public procurement, among other things, due to aviation fuel procurement and the chartering of cargo ships. Although these items are not very significant in monetary terms in government procurement, the high CO_2eq content per procurement Krone results in the procurement thereof having a relatively heavier weight in the total climate accounts.
- Finally, the share of Uncategorised procurement constitutes a relatively large portion of the government procurement, which is primarily due to the fact that there is no requirement for the self-governing sector to make their invoice data available[1)].

 1) This is described in more detail in Appendix 1.

The regions have relatively large emissions from the procurement area ‘Other Goods’, which, among other things, covers procurement from the medical devices and pharmaceutical industries

Figure 19: The climate footprint in Denmark and abroad of the regions' procurement (2019; 1,000 tons of CO2eq.)

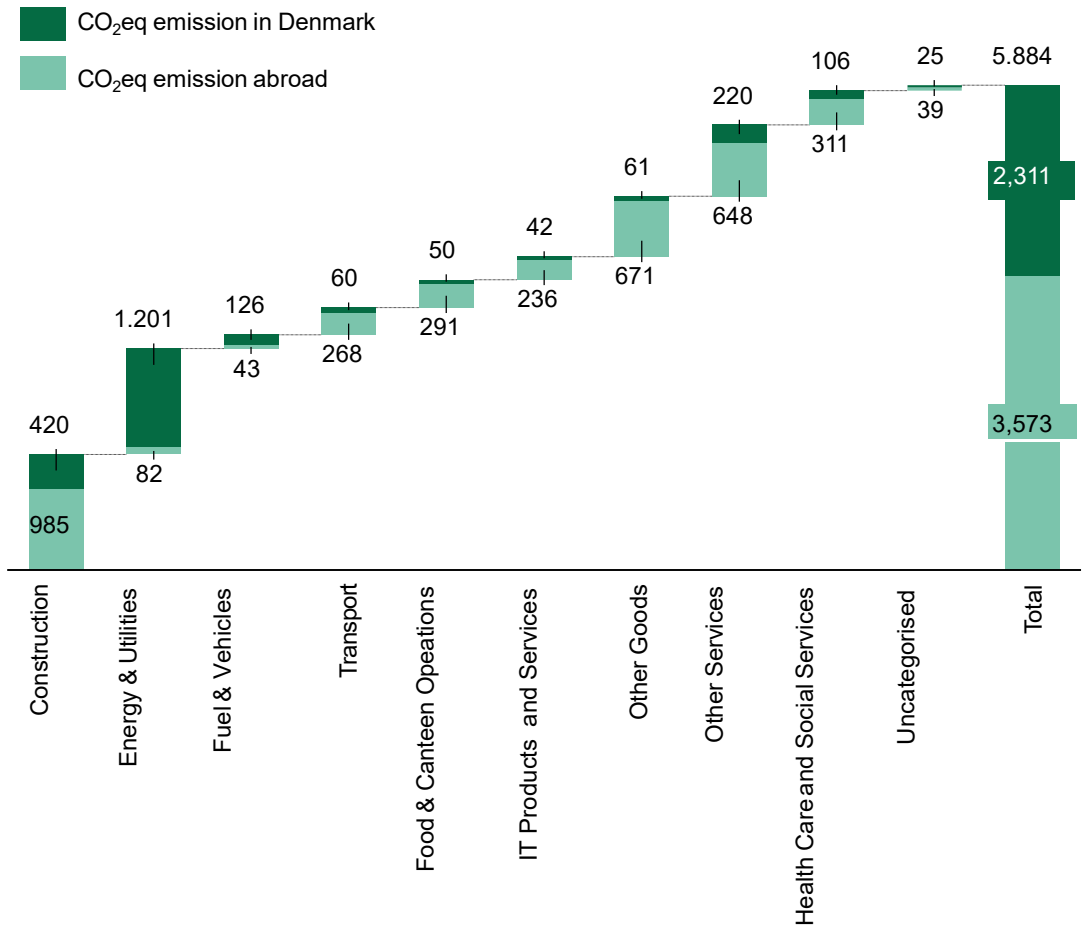


Results

- Figure 19 shows the distribution of the climate footprint of the regions' procurement between Denmark and abroad. Of the total climate footprint about 24 per cent of emissions occur in Denmark, while about 76 per cent occur in the countries that Denmark imports raw materials, semi-finished products and finished goods and services from.
- In relation to the government and the municipalities, a significant portion of the regions’ climate footprint originates from the procurement area ' Other Goods’. This procurement area covers areas such as the hospital sector’s procurement of equipment from the medical devices industry as well as of medicinal products from the pharmaceutical industry.

The municipalities' tasks and procurement volume result in large emissions from ‘Energy & Utilities’ and ‘Health Care and Social Services’

Figure 20: The climate footprint in Denmark and abroad of the municipalities' procurement (2019; 1,000 tons of CO2eq.)



Results

- Figure 20 shows the distribution of the climate footprint of the municipalities' procurement between Denmark and abroad. Of the total climate footprint about 39 per cent of emissions occur in Denmark, while about 61 per cent occur in the countries that Denmark imports raw materials, semi-finished products and finished goods and services from.
- The total emission based on municipal procurement must be seen in correlation with the fact that larger total procurement also generally leads to larger climate footprints.
- In relation to the government and the regions, a significant portion of the municipalities' climate footprint originates from the procurement area ‘Energy & Utilities’. This procurement area primarily covers the municipalities' procurement of electricity, district heating and natural gas and thus reflects the municipalities' relatively large building stock.
- In addition, a large portion of the climate footprint originates from the procurement area 'Construction’, which should be seen in context with the municipalities using, operating and maintaining a large number of buildings compared to the government and the regions.
- In relation to the total procurement volume, the municipalities also have a relatively large share of their procurement within the procurement area 'Health Care and Social Services’, which, among other things is due to the cost of social housing.

Conclusion and perspectives on further work

Conclusion

Emissions from public procurement in 2019 are calculated at DKK 12 million tons of CO2eq.
In 2019, public procurement led to the emission of 12 million tons of CO_2eq. The total public procurement covers a range of goods and services with a total procurement volume of DKK 184.6 billion Of the total emissions of 12 million tons, it was calculated that approximately 7.8 million tons were emitted abroad, while 4.1 million tons were emitted within the country's borders.

This is the first time that an assessment has been made of the climate footprint of total public procurement. This also means that the calculation cannot be compared with the trend from previous years, but instead points forward towards any recalculations and projections of the calculation.

Four procurement areas account for 67 per cent of the total climate footprint
Out of the total climate footprint of the area the four highest-emitting procurement areas are 'Construction', 'Energy & Utilities', 'Other Goods' and 'Other Services'. Procurement under these areas have a large procurement volume and a climate footprint of approximately 8 million tons, which corresponds to a little over 67 per cent of the total emission from publicprocurement.

In the procurement area 'Construction' the vast majority of the emissions come from contractor services . Similarly, the majority of emissions under the procurement area 'Energy & Utilities' originate from district heating and electricity. For 'Other Goods', the industry with the highest emissions is a group of medical devices and chemicals. Under 'Other Services', there are a number of different consulting services that have the largest emissions.

Each procurement area thus covers a plurality of industries, which contribute to varying degrees to the total climate footprint of the procurement area.

The calculation shows that emissions per procurement Krone are highest for the procurement areas 'Energy & Utilities' and 'Fuel & Vehicles'
In addition to the total emissions picture, a significant ratio is how large the emissions from a single procurement area is per procurement Krone. This also means that the greater the emission per procurement Krone, the greater the effect of any initiative in the area.

From the calculation it appears that the highest-emitting areas are 'Energy & Utilities' and 'Fuel & Vehicles'. 'Energy & Utilities' emit 158 grams of CO_2eq per procurement Krone, while 'Fuel & Vehicles' emit 192 grams of CO_2eq per procurement Krone. Although 'Fuel & Vehicles' is not one of the highest-emitting procurement areas in the total picture, the procurement area thus weighs heavily per procurement Krone.

Emissions in the sectors: The sectors' climate footprint reflects both the procurement volume and the content of the procurement
The calculation shows that the municipal sector emits 5.9 millions of tons CO_2eq, while the government emits 3.4 and the regional sector 2.7. The government's procurement includes the self-governing sector's procurement, which emits approximately one third of the total emissions from the area. The difference between the sectors partly reflects their respective procurement volume, but also the content of the procurement carried out by the different sectors. Compared to municipalities and regions, the climate footprint is larger per procurement Krone of the government's procurement. This is mainly due to the government procuring relatively more within the heavier procurement areas such as fuel.

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Perspectives on further work (1/2)

The potential and challenges of climate footprint calculation

The climate footprint calculation for the public procurement assesses both the total climate footprint of the public procurement and the volume of emissions at the sector and procurement area level. The climate footprint calculation can thus inform decision-makers about which industries they should focus on in particular if they want to reduce the climate footprint. However, the method must be refined significantly if it is to be used to indicate anything about a development over time, and which efforts, within a given industry, should be prioritised over others. For example, the method should in future be able to reflect the effect of the procurement being moved from a conventional to a green product, just as the calculation basis should be updated so that the emission figures are up to date. At the same time , the calculation is only a snapshot of the climate footprint, partly based on emission figures for 2011 and invoice data from 2019.

The following offers perspectives on further work based on the first climate footprint calculation of public procurement.

Efforts in the procurement area do not necessarily mean changes in the total supply

Analysing and evaluating effects of green initiatives is complicated. Among other things, this is due to the fact that public procurement has an advanced position in the value chain. Specifically, the actual procurement takes place *after* production. This means that a change in public demand does not necessarily result in corresponding changes in supply and production.

If the supply is the same, the production part of the value chain continues. This means that a large portion of the emission continues, even if the demand from the public procurement changes. For example, achange in public demand for beef will not necessarily mean that less beef is produced.

Whether supply and production follow public demand, is greatly affected by how large the public sector's shares are in the specific market, and how flexible the production capacity in each market is.

For that same reason, restructuring *earlier* in the value chain can also affect the climate footprint of public procurement. The climate footprint of a number of industries will thus - , all things being equal, decrease if energy production is reorganised so that renewable energy takes up more of the production of electricity.

These conditions have implications for the possibility to affect the projection of the climate footprint with measures within the procurement area.

Improvements in the calculation are a prerequisite for calculating the effect of specific green measures

There is a need for development of the analysis if we want to be able to predict and evaluate the effect of green measures within the procurement area.

More precisely, both the calculation model and the data basis must be developed so that the model can calculate the effect of green measures to a greater extent at product level, and so that the data basis is detailed enough to be able to perform this type of analyses.

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Perspectives on further work (2/2)

Adopted major measures that will affect the climate footprint of public procurement

Already at present, measures have been adopted, which are expected to affect the overall climate footprint of public procurement long-term. Of special importance is the ongoing restructuring of the electricity supply. This means that the emission from procurement areas such as 'Energy & Utilities' will be reduced towards 2028 based on the Danish Energy Agency's Basic Projection 2020[1)].

In addition, a number of policy initiatives have been taken that could also potentially have an impact. For example, the following can be pointed out:

- If the collaboration with the cement producer Aalborg Portland is honoured, the climate footprint of that company will decrease by over a quarter from approximately 2.2 million tons to approximately 1.6 million tons by 2030. Because Aalborg Portland is one of the biggest operators in the market for cement production, this initiative will also affect the climate footprint of public procurement. Specifically, the emissions from the procurement area 'Construction' will be reduced both directly with respect to the procurement of cement, but in particular indirectly through contractors who buy cement for public buildings and facilities[2)].
- The ambitions of the regions to reduce the climate footprint of the regional sector's electricity, heat and transport consumption by 75 per cent by 2030 will certainly continuously affect the climate footprint of the regional procurement[3)]. Among other things, the proposal highlights a restructuring of the regional car fleet, which will affect the sector's climate footprint in relation to 'Fuel & Vehicles'.
- If the municipalities' ambitions to succeed in restructuring the procurement area and reduce the climate footprint of the sector, these initiatives will also continuously affect the climate footprint of the sector's procurement in the coming years[4)].

These measures affect public procurement areas and sectors, which account for large emissions and will, therefore, eventually reduce the total climate footprint of public procurement. Exactly how much the measures will affect the climate footprint of public procurement will depend from whom and how much the public procures within the areas and within the specific sectors, which will require further analysis and projection.

1) https://www.danskenergi.dk/nyheder/ny-basisfremskrivning-allerede-groen-stroem-fra-2028
2) https://www.dr.dk/nyheder/politik/danmarks-storste-udleder-skal-skaere-660000-ton-co2.
3) https://www.altinget.dk/artikel/danske-regioner-overhaler-regeringens-klimamaal-vil-reducere-co2-udledning-med-75-procent-inden-2030
4) https://www.kl.dk/media/23572/faelleskommunal-indkoebsstrategi-2020-2024.pdf & https://www.kl.dk/media/22644/co2-reduktion-i-kommunerne.pdf

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Appendices

Appendix 1: Data basis for calculation of the climate footprint of public procurement – Data sources (1/4)

The data basis consists of invoice lines

The climate footprint of public procurement refers to CO_2eq emitted as a consequence of a product or service being produced, transported and, in the end, consumed as a result of of a procurement made by the public sector in Denmark in 2019.

In order to be able to calculate the climate footprint of public procurement, it is necessary to understand in detail which goods and services the public procures, as the climate footprint of the production of different types of goods and services varies a great deal.

In order to analyse the public sector's procurement, we have therefore used a data basis as detailed as possible, which is the product description in each invoice line in the millions of invoices (invoice data) sent to various public authorities during a year. The total amounts for identical product descriptions were then matched with the industries that supplied the product or service.

Sources of government invoice data

Government procurement is assessed as the government's and the self-governing sector's procurement from private suppliers. The amounts are stated in current prices excluding VAT. Credit notes have been deducted. Data was drawn on 11 July 2020.

Internal government payments have been deducted from the total amount. These are identified on the basis of public industry codes combined with selected public CVR numbers.

The invoice basis for the assessment of the government's climate footprint was compiled by the Danish Agency for Public Finance and Management from a composite database containing all approved invoices, which have been through the government's procurement and invoice management system 'IndFak', or a similar system in the institutions, who do not use IndFak (the Ministry of Taxation, the Ministry of Defence, Statens Serum Institut, Banedanmark (Danish railways) and the Danish Road Directorate).

Approx. DKK 3 billion of the Danish Defence's procurement in 2019, was not included in the climate footprint calculation, as the Danish Agency for Public Finance and Management does not have this data. This mainly concerns procurement from foreign suppliers.

Comparison between invoice data rather than accounting data

There are several methods for assessing public procurement. In order to validate the selected method, the Danish Agency for Public Finance and Management, therefore, conducted a comparison of public procurement based on Denmark's national accounts (approximately DKK 380 billion) and invoice data (approximately DKK 185 billion). The difference in the assessments can primarily be explained with the items; VAT, internal payments, public companies' procurement, rental expenses and missing invoices from the Danish Defence, which are not included in the foundation for the calculations of the climate footprint.

Invoice data is considered the best source for calculating the climate footprint, as it enriches the assessment of the procurement with a much higher level of detail, which is necessary in order to identify the correct emission factor for the specific procurement. In addition, the procurement is assessed based on expenses, so the emission factors are factored in for the year, during which the procurement was made, rather than being depreciated over several years.

1) "Public Information Online Universal Business Language". As a supplier to the government, a region and municipality, you must therefore send electronic invoices and credit notes to the public authorities in OIOUBL format through NemHandel

Appendix 1: Data basis for calculation of the climate footprint of public procurement – Data sources (2/4)

The invoice basis for the portion of the government's procurement, which is made by the self-governing sector, comes via the Danish Agency for Public Finance and Management's access to the invoice data of a number of self-governing institutions through IndFak (the Government's Procurement & Invoice Management System). The self-governing institutions for which the Danish Agency for Public Finance and Management has invoice data, make up 40 per cent of the total number of man-years in the sector, and for the remaining portion, the procurement is estimated by extrapolating this data based on man-years. Information regarding man-years used to make the estimate, has been obtained from the Ministry of Finance's ISOLA database[1)].

The sources for the municipalities' and regions' invoice data

The invoice basis for the municipalities' and the regions' procurement was provided by SKI and the Danish Regions, respectively.

The municipalities' invoice basis covers almost 98.75 per cent of the population, as five small municipalities are not included in the data collaboration with SKI.

Data from both municipalities and regions are categorised through machine learning on UNSPSC categories[2)] and are provided confidentially directly to NIRAS.

Data for the municipalities is categorised based on KMD's hierarchy, which builds onto the UNSPSC categories and, which are specially adapted to the municipalities. The data is detailed down to level 4 in KMD's hierarchy, resulting in 510 different product and service groupings.

The data for the regions covers all 5 regions in total and is detailed down to UNSPSC level 4, which gives approximately 7,500 different goods and service descriptions.

Rental costs are not included in the climate footprint analysis

Rental costs in this climate footprint analysis are not referred to as procurement and are, therefore, not included. However, operating and maintenance costs for buildings are included.

Additional travel data

Data for government travel expenses are supplemented with information from the government's travel agency, CWT, and an additional calculation of personal expenses for airline tickets in the joint government settlement system 'RejsUd'. In addition, payments were made for transit cards and single tickets with DSB (the Danish railway company), which have been delimited based on DSB's invoices to the respective government companies.

As some government institutions use systems other than RejsUd to settle travel, the figures do not include personal expenses for the entire government[3)]. The extent of expenses in these institutions is not known. The assessments of travel must be viewed as minimum estimates of the actual consumption within the area. However, it is estimated that a relatively small portion is missing and, therefore, does not significantly affect the final results.

Similarly, the municipalities' the and regions' data does not contain purchases, which employees themselves have made and have had reimbursed as personal expenses, just as transport allowance is not included in the calculation basis, either.

1) ISOLA is a collection of numerical bases for cross-governmental salary and personnel statistics
2) The UN standard product and service code taxonomy for e-commerce products and services; UNSPSC (United Nations Standard Product and Services Code)
3) Missing for the Ministry of Defence, the Ministry of Taxation, SSI, the Danish railways and the Danish Road Directorate

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Appendix 1: The data basis for the calculation of the climate footprint of public procurement - Data processing (3/4)

Government procurement categories

Government procurement is basically posted under one of 81 possible procurement categories, which were, therefore, used to match the total procurement volume at the aggregate level in each procurement category with the industries providing the goods and services that the 81 procurement categories each cover. The ministries manually record their procurement according to the procurement categories and the recordings are thus confirmed with a certain degree of uncertainty. The Danish Agency for Public Finance and Management has validated the categorisation for the largest amounts.

It was necessary to manually finish three of the government procurement categories, as these could not be matched directly with industries: 'Institution-specific goods/services' as well as invoices with an "Unknown" procurement category. Larger invoices in this category were reviewed at product line level and/or supplier level, and were subsequently manually placed under an industry, e.g. based on the supplier's industry code in the CVR register. However, the manual processing weakens the replicability of the method.

Regional and municipal UNSPSC codes

The regions' and the municipalities' invoices were mechanically processed using text recognition and machine learning. Each invoice line has hereby been classified according to UNSPSC. As a result, identical invoice lines were grouped, and subsequently aggregated on a smaller number of product and service areas. The municipalities' data was then aggregated from KMD's goods and services hierarchy, which was specially adapted to the municipalities.

Finally, these were matched with a supplying industry in the same way as the government procurement categories.

Reservations must be made for the fact that since the categorisation was made by a machine, there may be errors.

Categorisation and extrapolation of the self-governing sector's invoice data

Institutions in the self-governing sector are not obliged to categorise their procurement into procurement categories, as is the case for the government. However, the available data contains information about the supplier, and where possible, the self-governing institutions' procurement from a given supplier has been assigned procurement categories based on which procurement categories government institutions assigned procurement from with same supplier: If the government institutions' procurement from supplierA for example invoiced at 20 per cent on the procurement category "Cleaning Services" and 80 per cent on the procurement category "Laundry Services and Rent of Textiles", the self-governing institutions' procurement from supplier A is invoiced with the same distribution among the categories. This is based on the assumption that the self-governing institutions' procurement from a given supplier generally resembles government institutions' procurement from the same supplier.

Extrapolation of the municipalities' invoice data

The total amounts for municipalities' procurement data was extrapolated by 3 per cent, to compensate for the fact that not all municipalities provide invoice data, and for analyses to show that approximately 15 per cent of invoice data for December 2019 as well as a smaller share for November were not submitted to SKI at the time of categorisation.

NIRAS ØKONOMISTYRELSEN

Appendix 1: Data basis for calculation of the climate footprint of public procurement - Data processing (4/4)

Uncategorised procurement data

However, there is a certain portion of both the government's and the self-governing sector's data basis that, even after manual inspection of invoice lines or bookkeeping texts, could not be matched with a supplying industry, and these remaining amounts were included in the calculation under 'Uncategorised'.

Similarly, there is a large number of invoices in both the regions' and the municipalities' invoice basis, where the product descriptions were so inadequate, that they could not be classified in the UNSPSC category tree, or they were classified with a UNSPSC text, which is so ambiguous that the amount cannot be immediately matched with an industry in the Danish industry statistics

Finally, a number of smaller amounts remain which have not been matched with a supplying industry and which were, therefore, also included under Uncategorised.

In total for the government and the self-governing sector, DKK 6.4 billion was not categorised; DKK 5.35 billion for the self-governing sector and DKK 1.05 billion for the government.

For the regions, this amounts to about DKK 1.15 billion, of which DKK 750 million is marked as "No match" in the data basis. In addition, due to a resource shortage caused by the COVID-19 situation in Denmark, clarification about a single large amount of DKK 364 million remains concerning 'Supply'. Finally, no match was made with industries of 786 lines with smaller amounts, which total just under DKK 36 million.

For the municipalities, DKK 1 billion were not categorised. Of this, DKK 783 million is due to the fact that the category is only stated as 'Wholesale', 'Retail' or 'Procurement of Miscellaneous Goods', which does not allow for the identification of the underlying product that was invoiced. In addition, invoices for DKK 238 million have no classification at all.

Omitted amounts

Amounts that in the data basis were classified as subsidies, inter-municipal payment, rent, taxes, fees, other fees, deductions and supplements are all amounts not considered procurement, and and have therefore been removed from the climate footprint calculation.

Processing of negative procurement data

The regions' invoice data contains a number of negative amounts, corresponding to DKK -2.9 billion, of which DKK 2.1 billion originate from the set-off of on-account payments in connection with the final invoicing for construction services, and the amount was therefore deducted from the total amount procured from the construction industry. Furthermore, an amount of DKK -150 million for rescue services were set off against ambulance services, DKK-15 million were set off against the remaining postage and shipping costs, and DKK -9 million were set off against other clothing procurement. Other negative amounts, including DKK 643 million marked as rebates, were not set off in the calculation of the climate footprint.

The municipal data contains negative amounts for a total of DKK -234 million, of which 232 million are marked as "Deductions, allowances & fees" and are hence not included in the calculation.

NIRAS ØKONOMISTYRELSEN

Appendix 2: The calculation model is based on an industry-based value chain analysis, which goes all the way back to the extraction of raw materials

The calculation model is based on an industry-based value chain analysis

The calculation model is based on the fact that all procurement, public as well as private, is procured from a specific industry in the overall Danish economy. However, an industry can never produce and supply a product or service in isolation, but is dependent on goods or services from other industries. Of these, some may have been imported from industries abroad. And these industries are dependent on a number of other domestic and foreign industries, and so on until one has followed a product or service all the way back through the value chain to the raw material consumption.

Multi-Regional Input-Output tables (MRIOs) are statistical tables of industries' production, energy consumption, value added, land use, etc. They also describe the trade that takes place within and between the various industries - both nationally and internationally, and both in amounts and in quantities. Thereby an industry's production (Output), can be traced back to which other industries have provided goods and services (Input), in order for the given industry to be able to produce the goods and services it itself supplies.

The calculation model EXIOBASE converts the MRIO tables to an industry-specific amount of emission per procurement Krone

The core of the calculation model for public climate footprints is the EE-MRIO table EXIOBASE. EE - Environmentally Extended - means that the MRIO tables are enriched with a wide range of different environmental data, such as about heavy metals, particulate emissions and emissions of CO_2 and CO_2 equivalents.

Hereby, one can also calculate what the climate footprint has been along the way through the path of a product or service through the value chain. The climate footprint can thus also be divided into, the size of a footprint that was emitted along the way in the part of the value chain that occurred in Denmark, and the size of a footprint that was emitted abroad.

How are an industry's emissions assessed?

The total emissions from an industry can thereby be assessed as the sum of the industry's own emissions, plus its value or quantitative features on other industries and their emissions. When comparing this to the industry's total value output, this provides a number for, which emissions, measured as emissions per Krone are included in the goods and services the industry provides. This number varies from industry to industry.

How large a share of the climate footprint is due to the public procurement?

When the public sector in Denmark procures a certain share of an industry's total production, the principle of the calculation model is, therefore, the fact that the public sector thereby decreases a corresponding share of the industry's total emissions.

Specifically, the climate footprint is, therefore, calculated by multiplying invoice amounts for supplies from a given industry with the emissions per procurement Krone that the calculations in EXIOBASE show that the industry in question causes.

NIRAS ØKONOMISTYRELSEN

Appendix 3: The link between the climate footprint of public procurement and the 70 per cent target

The climate footprint calculation is based on a consumption-based approach

The assessment of the climate footprint of public procurement is based on a consumption-based approach. This means that emissions of CO_2eq are assessed at the time when the product or service is consumed, rather than at the time at which it was originally produced. Similarly, emissions are also included in the country where the product or service is consumed, rather than in the country where it was originally produced. This approach is necessary to be able to calculate the exact climate footprint of procurement.

The 70 per cent target is based on a production-based approach

The 70 per cent target is based on the UN's assessment principles, which is a production-based approach. Emissions of CO_2eq are based on, where and when the product or service is produced, regardless of where, when and by whom it is, in the end, consumed.

The difference between a production-based and consumption-based approach

Because there is a difference in what is produced and consumed in Denmark, the calculation of the climate footprint of public procurement and the 70 per cent target have not been compared directly. Specifically, this is due to the fact that part of the calculated footprint in the climate footprint calculation is not included in the 70 per cent objective, and, similarly, that part of what is included in the 70 per cent target is not included in this climate footprint calculation.

Despite the differences in the assessment methods, however, there are correlations between the assessments, and hence the possibility to compare the results to an extent.

The climate footprint of the procurement of electricity, heat and fuels

For the portion of the climate footprint that originates from the consumption of electricity, district heating, natural gas and fuels, there is no significant geographical or temporal displacement between the time and place of production and the time and place of consumption.

The climate footprint of this can therefore be directly compared with the 70 per cent target and will be a subset of this. The public consumption of fuels, and the emissions from these, are unambiguously attributed to the Danish production, and a reduction in the public consumption can be read from the national accounts. Likewise, the majority of the public electricity and district heating needs is produced in Denmark, and emissions from here are included in the national climate accounts.

Comparison of the Danish climate footprint and the 70 per cent target

The other goods and services that make up the total public procurement originate, to varying degrees, from abroad. In this analysis, it has therefore been calculated how big a share of the total emissions were emitted in Denmark. This share of the climate footprint of public procurement can be compared with the 70 per cent target.

NIRAS ØKONOMISTYRELSEN

Appendix 4: Method for calculating the climate footprint of electricity, heat and fuel consumption

Calculation of the climate footprint of fuel

Government, regional and municipal consumption of fuels was converted from consumption calculated in amounts based on invoice data, to consumption volumes in litres based on an average litre price.

The litre prices for petrol, diesel, heating oil, and marine gas oil, respectively, are based on SKI's winning tender prices on the agreement 50.85 Fuel and heating oil. The litre price for aviation fuel is based on the collection of market prices in connection with preparing the report "Sustainable jet fuel for aviation", prepared by Wormslev, et al., for the Nordic Council. The consumption of other fuels such as e.g. wood pellets have been converted based on average prices in the market.

The climate footprint of fuel consumption was not calculated on the basis of industry emission coefficients from EXIOBASE, but was calculated based on emission coefficients for the specific fuel types procured. The emission coefficients were obtained from the DEFRA database, which also takes into account upstream emissions from extraction, refining and transport of the fuels, which amounts to approx. 15-20 per cent of the total climate footprint.

Calculation of the climate footprint of electricity, heat and natural gas

For the government, the climate footprint of electricity, heat and natural gas was calculated on the basis of consumption data for 2018 from the OEF database for buildings, which the government, incl. self-governing institutions, use, own and rent. This consumption was projected to 2019 based on the historical trend, and subsequently validated against the total invoiced amounts in 2019. Consumption volumes were subsequently converted to emissions based on emission coefficients for 2019 from Energinet (the Danish Energy System) and the Danish Energy Agency.

The climate footprint of the regions' consumption of electricity, district heating and natural gas in 2019 is based on consumption data from 2018, which was collected as part of the project "Common Regional Baseline for the Regions' Climate Footprint, 2018", carried out by NIRAS for the Danish Regions in the spring of 2020. This consumption data has also been validated against the total invoices, and subsequently converted to CO_2eq. Emission factors for electricity and district heating are based on 2019 data from Energinet and the Danish Energy Agency.

For the municipalities it was not possible to find a source for assessment of the total energy consumption, and the climate footprint was therefore converted directly from invoice data based on the price/volume ratio applicable in the regions where a very detailed data basis is available for energy consumption.

The climate footprint of district heating was calculated using an emission factor based on the national average for district heating. For the regions and municipalities, this is considered to be accurate. Government consumption, on the other hand, is not evenly distributed across district heating companies, but is preferably supplied from HOFOR, whose emissions are below the national average. Therefore, the government's climate footprint of district heating may be overestimated.

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Appendix 5: EXIOBASE

EXIOBASE version

For the calculation of the climate footprint of public procurement, EXIOBASE was used v. 3.3.16b2, calculated according to the method ”Stepwise 2006 V1.07/Europe95 person/EUR excl. biogenic C”. The calculation includes Capital Goods and Indirect Land Use Change (iLUC).

For the calculation, a special extraction was made, which enables an assessment of the total emissions in the Danish contribution and the contribution from the rest ofthe world, respectively. This extraction was performed on 10 August 2020.

Emission coefficients for the energy sector

The statistical data in the MRIO tables in EXIOBASE are, in the current version, from 2011. This has great significance as to with which emission coefficients an industry's energy consumption are included in the calculations.

As the energy system, especially in Denmark, has undergone a major transformation since 2011, an attempt was made to compensate so that this development was not reflected in EXIOBASE 2011, by applying a marginal consideration for the energy consumption rather than an average consideration.

In practice, this means that e.g. for an industry’s electricity consumption, emissions are not factored in based on the average electricity mix in 2011 (just under 0.5 kg CO_2/kWh), but based on what the emission would be if one kWh more were to be produced (which in 2011 would be mainly wind energy with about 50 grams of CO2/kWh).

Split EXIOBASE categories

Two industries in the Danish industry statistics cover activities where the material is reported separately under different procurement areas.

This concerns the industry Hotel and restaurant business, which is split into "Hotels" and "Restaurants", respectively.

Here, the invoice amount for hoteland conference bookings are included under the procurement category "Other Services", while invoice amounts for restaurant visits and other catering are included under the procurement category "Food & Canteen Operations". For the latter, however, the industry in the material is referred to as "Canteen Operations, etc." as invoices for canteen operations constitute the largest entries in the data material.

Furthermore, the industry "Post and Telecommunications", is therefore split into "Postal services” and “Telecommunications”, respectively. Here, postal services and courier services are included under the procurement category "Other Services", while telecommunications, mobile and satellite communications are included under the procurement category "IT Products and Services".

Where the procurement category (for government data) or the UNSPSC text (for regional and municipal data) has not allowed a unique allocation of the amount to one of these subclassifications, a 50/50 distribution of the amount has been made.

Handling of emissions from waste management

EXIOBASE only contains emission coefficients for the handling of specific types of waste, while it is not specified in the invoice basis which types of waste or which quantities are disposed of.

Therefore, a "basket" of different types of waste management and their respective climate footprints was created, based on an average composition of residual waste calculated by the Danish Environmental Protection Agency. The average emission per procurement Krone for this "basket" was subsequently used to calculate emissions from waste management. The same emission factor for the incineration of residual waste was also used for the Danish Business Authority's CO_2 calculation.

Appendix 6: List of procurement areas, industry codes and EXIOBASE categories (1/3)

Procurement area	EXIOBASE category	Danish Industry Statistics	Name used in this report
Construction	Products of forestry, logging and related services (02)	02 Forestry, etc.	Products from forestry
	Stone	14.1 Stone mining, etc.	Stone mining, etc.
	Sand and clay	14.2 Gravel, sand and clay excavation	Gravel, sand and clay excavation
	P and other fertiliser	24.15 Manufacture of fertilisers, etc.	Fertilisers, etc.
	Cement, lime and plaster	26.5 Manufacture of cement, lime and plaster	Cement, lime and plaster
	Ceramic goods	26.3 Manufacture of tiles and slabs	Tiles and other ceramic goods
	Other non-metallic mineral products	26.82 Asphalt, roofing felt and stone wool factories, etc.	Asphalt, roofing felt and stone wool factories, etc.
	Basic iron and steel and of ferro-alloys and first products thereof	27.1 Iron and steelworks	Iron and steel products
	Aluminium and aluminium products	27.42 Manufacture andfirst machining of aluminium	Aluminium and aluminium products
	Other non-ferrous metal products	27.45 Manufacture and first machining of other non-ferrous metals	Products of non-ferrous metals
	Construction work (45)	45 Construction	The Construction industry
Energy & Utilities	Coal, lignite and peat	10 Coal mines, lignite deposits and peat pits	Coal mines, lignite deposits and peat pits
	Distribution and trade services of electricity	40.1 Electricity supply	Distribution and trade with electricity
	Biogas and other gases nec.	40.2 Gas supply	Manufactured gases
	Distribution services of gaseous fuels through mains	40.2 Gas supply	Distribution of gas fuels (with line-based supply system and storage facilities)
	Steam and hot water supply services	40.3 Heat supply	Heat supply
	Collected and purified water, distribution services of water (41)	41 Water supply	Water supply
	Other waste for treatment: wastewater treatment	90 Sewage, waste disposal, cleaning, etc.	Wastewater treatment
	Not calculated using EXIOBASE	Not compared to Danish industries	Electricity
			Natural gas
			District heating
			Wood pellets
			Heating oil
Fuel & Vehicles	Refined petroleum	23.2 Manufacture of refined mineral oil products	Manufacture of refined mineral oil products
	Motor vehicles, trailers and semi-trailers (34)	34 Manufacture of vehicles, etc.	Vehicles
	Other transport equipment (35)	Manufacture of other means of transport	Other transport equipment
	Sale, maintenance, repair of motor vehicles, motor vehicle parts, motorcycles, motorcycle parts and accessories	50 Trade with cars, etc., repair and maintenance thereof and service stations	Repair and maintenance of motor vehicles
	Not calculated using EXIOBASE	Not compared to Danish industries	Diesel
			Petrol
			Jet fuel
			Marine gas oil
			Uncategorised fuels

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Appendix 6: List of procurement areas, industry codes and EXIOBASE categories (2/3)

Procurement area	EXIOBASE category	Danish Industry Statistics	Name used in this report
Transport	Railway transport services	60.1 Railways	Rail transport
	Other land transport services	60.2 Other land transport	Other land transport
	Sea and coastal water transport services	61.1 Sea and coastal transport	Shipping industry
	Air transport services (62)	62 Air transport	Air transport
	Supporting and auxiliary transport services; travel agency services (63)	63 Auxiliary services related to transport; travel agency business and transport intermediation services	Auxiliary services for transport; travel agency services
	Not calculated using EXIOBASE	Not compared to Danish industries	Ambulance services
Food & Canteen Operations	Cereal grains nec	01.11 Farming	Cereal products
	Vegetables, fruit, nuts	01.12 Garden centres and nurseries and 01.13 Growing of fruit and berries	Vegetables, fruit and berries
	Animal products nec	01.25 Other livestock breeding	Other livestock breeding
	Fish and other fishing products; services incidental of fishing (05)	05 Fishery, etc.	Fishery and fishery products
	Products of meat cattle	15.1 Slaughter, processing and preservation of meat and meat products	Beef
	Products of meat, pigs	15.1 Slaughter, processing and preservation of meat and meat products	Pork
	Products of meat, poultry	15.12 Poultry slaughterhouses	Poultry
	Meat products nec	15.1 Slaughter, processing and preservation of meat and meat products	Other meat products
	products of vegetable oils and fats	15.4 Manufacture of vegetable and animal oils and fats	Vegetable and animal oils and fats
	Dairy products	15.5 Manufacture of dairy products	Dairy products
	Food products nec	15 Preparation of food and beverages	Other food
	Beverages	15.9 Manufacture of beverages	Beverages
	Fish products	15.2 Processing and preservation of fish and fish products	Fish
	Hotel and restaurant services (55) (Canteen)	Hotel and restaurant business	Canteen Operations
IT Products and Services	Office machinery and computers (30)	30 Manufacture of office equipment and computer equipment	Office machines and computer equipment
	Electrical machinery and apparatus n.e.c. (31)	31 Manufacture of other electrical machines and apparatus	Electrical machines and apparatus
	Radio, television and communications equipment and apparatus (32)	32 Manufacture of telecommunications equipment	Radio, television and communications equipment and apparatus
	Postal and telecommunications services (64) (telecommunications)	64 Postal and telecommunications	Telecommunications
	Computer and related services (72)	72 Data processing services	Data processing services
Other goods	Chemical and fertiliser minerals, salt and other mining and quarrying products n.e.c.	14.3 Extraction of minerals for the manufacture of chemical products and fertilisers, 14.4 Salt extraction and 14.5 Other raw material extraction	Chemical minerals and fertiliser minerals, salt and other mining and quarry products not mentioned elsewhere
	Tobacco products (16)	16 Tobacco factories	Tobacco products
	Textiles (17)	17 Textile industry	Textiles
	Wearing apparel; furs (18)	18 Clothing industry	Clothing
	Leather and leather products (19)	19 Leather industry	Leather products

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Appendix 6: List of shopping areas, industry codes and EXIOBASE categories (3/3)

Procurement area	EXIOBASE category	Danish Industry Statistics	Name used in this report
	Wood and products of wood and cork (except furniture); articles of straw and plaiting materials (20)	20 Timber industry	Wood and products of wood and cork
	Paper and paper products	21 Paper industry	Paper and paper products
	Printed matter and recorded media (22)	22 Graphicindustry	Printed matter and recorded media
	Plastics, basic	25 Rubber and plastics industry	Manufacture of base plastics
	Chemicals nec; additives and biofuels	24 Chemical industry	Chemicals
	Rubber and plastic products (25)	25 Rubber and plastics industry	Products from the Rubber and plastics industry
	Glass and glass products	26.1 Manufacture ofglass and glass products	Glass and glass products
	Fabricated metal products, except machinery and equipment (28)	28 Iron and metal goods industry	Manufactured metal products
	Machinery and equipment n.e.c. (29)	29 Machinery industry	Machines and equipment
	Medical, precision and optical instruments, watches and clocks (33)	33 Manufacture of medical equipment, instruments, clocks, etc.	Equipment, instruments, clocks, etc.
Other Services	Hotel and restaurant services (55) (hotel)	Hotel and restaurant business	Hotel
	Postal and telecommunications services (64) (postal services)	64 Post and telecommunications	Postal services
	Financial intermediation services, except insurance and pension funding services (65)	65 Financial institutions and financing business	Financial intermediation services
	Insurance and pension funding services, except compulsory social security services (66)	66 Insurance business	Insurance and pension
	Real estate services (70)	70 Business related to real estate	Real estate services
	Renting services of machinery and equipment without operator and of personal and household goods (71)	71 Renting of cars, machines, equipment, etc.	Renting of cars, machines, equipment,etc.
	Research and development services (73)	73 Research and development	Researchand development
	Other business services (74)	74 Other business services	Other business services
	Public administration and defence services; compulsory social security services (75)	75 Public administration, defence and social insurance	Public administration, defence and social insurance
	Educational services (80)	80 Instruction	Educational service
	Oil/hazardous waste for treatment: incineration	90 Sewage, waste disposal, cleaning, etc.	Oil / hazardous waste for treatment: incineration
	Sewage sludge for treatment: biogasification and land application	90 Sewage, waste disposal, cleaning, etc.	Sewage sludge for treatment: biogasification and use of soil
	Membership organisation services n.e.c. (91)	91 Organisations and associations not mentioned elsewhere	Organisations and associations not mentioned elsewhere
	Recreational, cultural and sporting services (92)	92 Amusement, culture and sports	Amusement, culture and sports
	Other services (93)	93 Other service business	Other service business
	Not calculated using EXIOBASE	Not compared to Danish industries	Waste disposal
Health Care	Healthcare and Social Services (85)	85 Healthcare system and social services	Health Care system and social services
Uncategorised	Not calculated using EXIOBASE	Not compared to Danish industries	Un categorised

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