AARSTIDERNE

CO_2 accounts for Aarstidernes box scheme business

2012-2017

June 2018

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1.0 Introduction

At Aarstiderne we keep an eye on the effect our business has on our surroundings as a natural part of being a company dealing with organic foodstuffs every day. Therefore, we have calculated our CO_2-footprint from the point when the goods are collected from our suppliers, such as farmers and gardeners, until they arrive at the doorstep of our customers.

The calculations in this report include quite a lot of transport to get the goods from different places in Denmark (e.g. Mariager & Odense), France (Nantes), Germany (Hamburg), Spain (Barcelona), Italy (Verona), a small number of overseas destinations and many more destinations.

When the goods arrive at our packing center at Barritskov, we unpack all the individual packages, the quality department are controlling the produce and we put them into the correct boxes. The boxes are placed on pallets for the different regions of the country and are driven with lorries to 9 distribution centers in Denmark and 4 distribution centers in Sweden. From the distribution center the boxes are driven with vans to the doorstep of our customers. Along the way we have added newsletters and recipes into the boxes to help our customers enjoy the food at home, and further developed the concept to include meal boxes. The latter is now the main product. Furthermore, we drive in cars and hold meetings to ensure business success. And we use oil, gas, electricity, refrigeration systems and wood chips to keep warm and to run various cooling- and packing processes along the way.

All data have been collected via our ERP-system or best possible estimations made by our staff at Aarstiderne.

To ensure a professional foundation for the calculations, we cooperate with the green think-tank CONCITO, who has produced the emission factors, that are used to calculate the CO_2 equivalent (CO_2e) emissions from each activity. Thanks a lot, Torben Chrintz, Chief Knowledge Officer at CONCITO for this priceless assistance.

The calculations of CO_2 equivalent emission are estimated for a 6-year period (2012-2017), and instead of using the technical term CO_2e emission we will use "CO_2 emission", as a synonym for CO_2e emission during the report.

A larger expansion of our production frame in 2016 was established to fulfill the rising demand for meal boxes from Aarstiderne. This led to a higher CO_2 emission in 2016 than the years before. The calculations for 2017 shows as expected a higher effectivity with the new packing facilities than before.

When the turnover per DKK rise with utilization of a given production framework, which is seen in the period 2012-2017, it is relatively easy to achieve an improved utilization of the resources. The detailed analysis shows, that several conscious actions to organize the resource efficiency of the production have succeeded during this process and have been instrumental in the improvements. It is a satisfying result regarding both financial and CO_2 emission circumstances. In the coming years the challenge will be to maintain and preferably improve the good momentum of our carbon footprint.

2.0 Key figures

Relating to the high number of tons of CO_2 emissions from Aarstiderne can be difficult. Therefore we express our emission of CO_2 as "kg CO_2 per drop" and "kg CO_2 per DKK 1,000 generated (in 2015 DKK)".

To relate to the unit **"kg CO_2"** three examples are shown below:

1) A person in a medium car emits 0.133 kg CO_2 per km driven.
   So a person has emitted **1 kg CO_2 after driving 7.5 km** (www.co2nnect.org).
2) Consumption of **approx. 2.1 kWh** = emission of 1 kg CO_2 (www.videnskab.dk).
3) A daily meal for women (18-30 years old – 10,5 MJ) emits **1.39 kg CO_2**, and a daily meal for men (18-30 years old – 13,2 MJ) emits **1.74 kg CO_2.** (www.studieportalen.dk).

Aarstiderne´s selection of boxes has in the period 2012-2017 changed rapidly from a majority of vegetable and fruit boxes in 2012 to a clear majority of meal boxes in 2017.
According to **Table 1** the total CO_2 emission has decreased approx. 5 % measured per drop in the period 2012-2017, which corresponds to index 95, but the CO_2 emission measured by revenue decreased approx. 25 %. The development regarding CO_2 emission per drop is explained by the turnover per drop being increased during the period 2012-2017. A relatively large decrease in CO_2 emission per DKK 1000 generated shows the "real" effect of increased production, investments and higher efficiency on our CO_2 emission.

Table 1. Total tons CO_2 emitted, kg CO_2 per drop and kg CO_2 per DKK 1000 generated (in 2015 DKK) during 2012-2017. Furthermore, the development during 2012-2017 shown as index according to 2012.

Turnover and CO_2 emission	2012	2013	2014	2015	2016	2017
Turnover figure in 2015-DKK [1000 DKK]	243.534	290.912	349.681	428.747	521.152	611.302
Index (turnover compared to 2012)	**100**	**119**	**144**	**176**	**214**	**251**
Total tons CO_2	2.965	3.116	3.635	4.137	5.075	5.587
Index (development of total kg CO_2)	**100**	**105**	**123**	**140**	**171**	**188**
kg CO_2 per drop	3,45	3,41	3,40	3,25	3,40	3,29
Index (development of kg CO_2 per drop)	**100**	**99**	**99**	**94**	**99**	**95**
kg CO_2 per DKK 1000 generated	12,18	10,71	10,40	9,65	9,74	9,14
Index (develop. of kg CO_2 per DKK 1000)	**100**	**88**	**85**	**79**	**80**	**75**

According to **Figure 1** the CO_2 emission has been higher in 2016 compared to 2017, due to production line extensions at Barritskov with larger cooling capacity, which has resulted in an increased consumption of electricity. The transport from grower and the energy consumption has also contributed to an increase in kg CO_2 per drop in 2016 compared to 2017, whereas CO_2 emission from intermediate transport and packaging use increased from 2016 to 2017. During the entire period 2012-2017 kg CO_2 per drop from packaging and energy consumption has decreased, due to a larger number of boxes being recycled, primarily EPS foam boxes, a replacement of plastic cups with plastic bags in the packaging machine and installation of energy effective cooling system and light sources in the packing department at Barritskov.

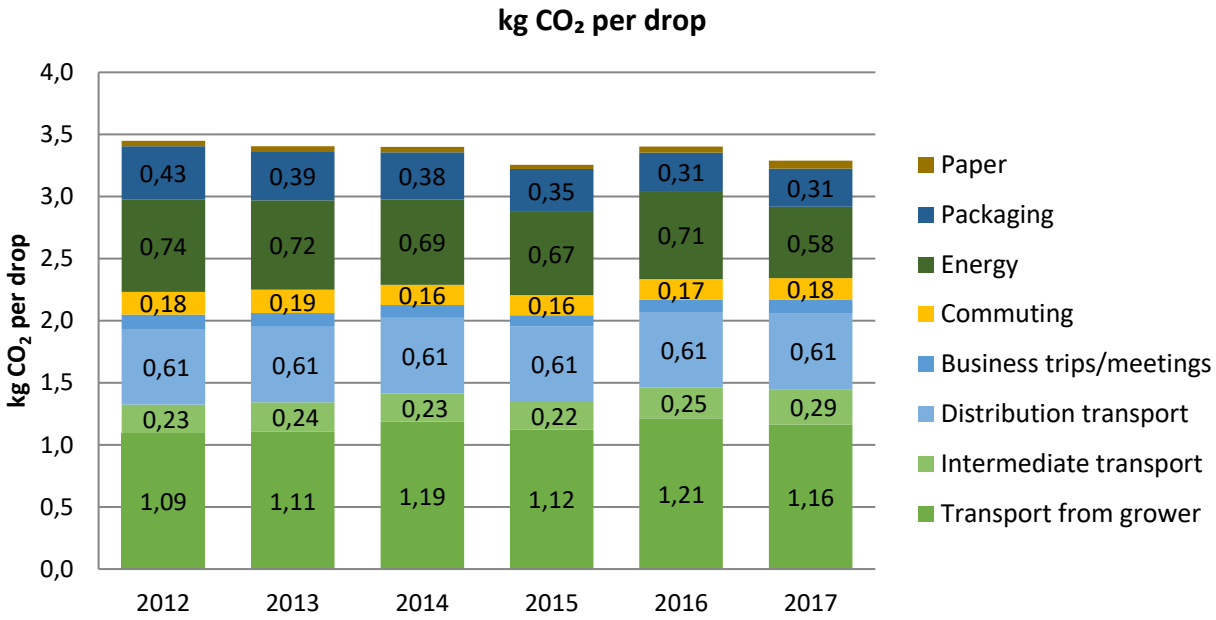

Figure 1. The contribution from transport, energy, paper & packaging to kg CO_2 per drop in the period 2012-2017.

As seen in **Figure 2** the contribution from intermediate transport to kg CO_2 per DKK 1000 generated has increased from 2015 to 2016. But the contribution from distribution transport to kg CO_2 per DKK 1000 generated has decreased from 2015 to 2016, as well as the contribution from energy consumption to kg CO_2 per DKK 1000 generated has decreased in the period 2012-2015, with a small increase from 2015 to 2016 due to rebuilding new and larger storage facilities.

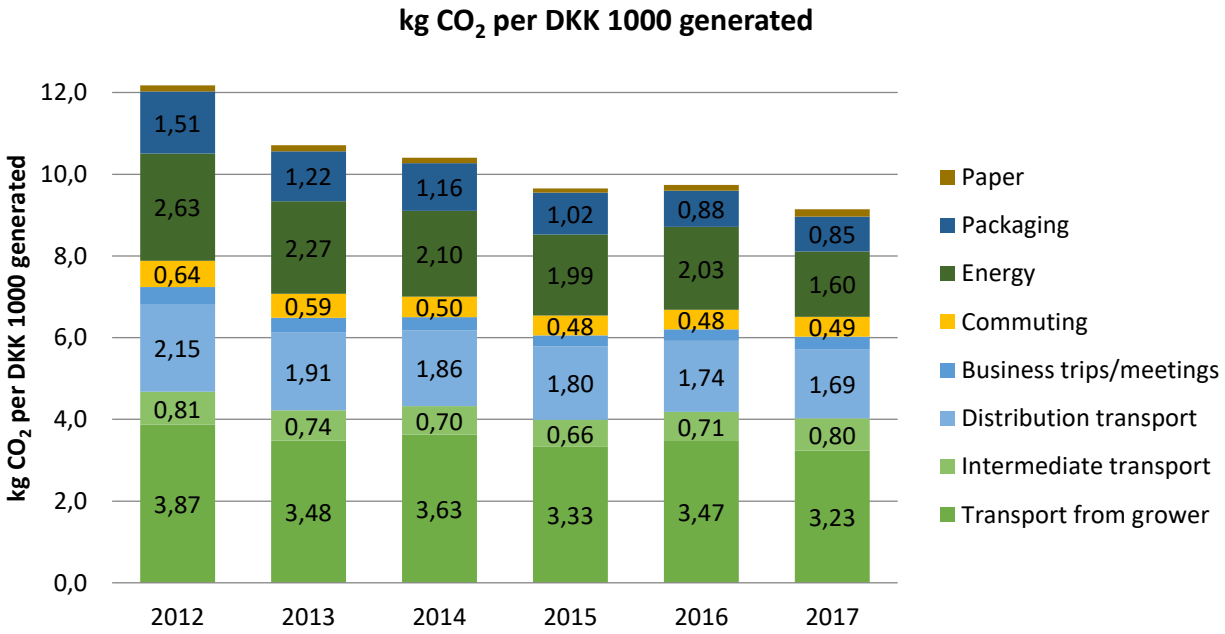

Figure 2. The contribution from transport, energy, paper & packaging to kg CO_2 per DKK 1000 generated in the period.

In **Figure 3** the percentage of the CO_2 emission from the different categories in 2017 are shown. As mentioned before the part of the emission from the three transport categories is huge – around 2/3 of the total CO_2 emission in Aarstiderne. The next big categories with close to 10 % and 20 % of the total emission are energy and packaging.

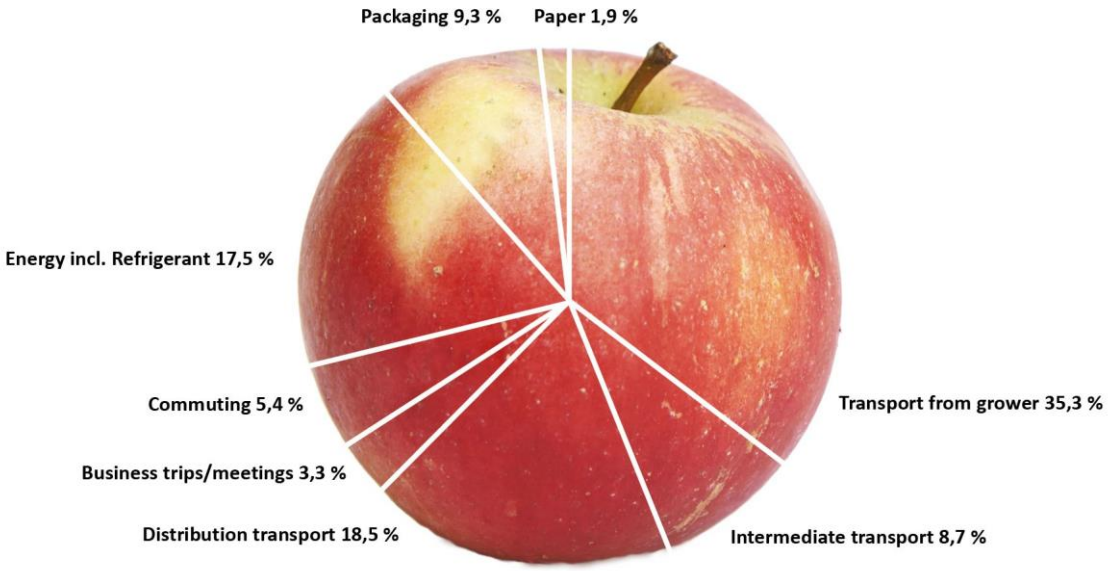

Figure 3. The percentage of the total CO_2 emission from the different categories (transport, packaging, energy, commuting, business trips/meetings and paper), 2017.

According to **Table 2** each category (paper, commuting, business trips, energy and distribution transport) is quite stable in relation to the CO_2 emission measured during the period 2012-2017, but the CO_2 mark from energy decreased in 2017. The percentage of the CO2 emission from packaging has decreased during the period 2012-2016, whereas transport from grower and intermediate transport has increased during the years. And transport from grower is clearly our largest item in the total CO_2 account and represent more than 1/3 of the CO_2 emission in 2017. The contribution from all transport is almost 2/3 of the total CO_2 emission at Aarstiderne in 2017.

Table 2. The contribution from transport, energy (incl. refrigerant) & packaging to kg CO_2 for the period 2012-2017. And percentage of the total kg CO_2 the different groups (transport, energy, packaging and paper) represent.

2012-2014	2012		2013		2014	
	Kg CO_2	%	Kg CO_2	%	Kg CO_2	%
Transport from grower	941.641	31,8	1.011.836	32,5	1.268.554	34,9
Intermediate transport	196.675	6,6	215.874	6,9	243.340	6,7
Distribution transport	523.111	17,6	556.638	17,9	650.272	17,9
Business trips/meetings	100.959	3,4	102.014	3,3	111.808	3,1
Commuting	156.149	5,3	171.623	5,5	171.917	4,7
Energy incl. refrigerant	640.288	21,6	659.208	21,2	735.647	20,2
Packaging	368.882	12,4	355.511	11,4	406.957	11,2
Paper	37.565	1,3	43.105	1,4	46.562	1,3
Total	**2.965.269**	**100,0**	**3.115.809**	**100,0**	**3.635.058**	**100,0**
2015-2017	**2015**		**2016**		**2017**	
	Kg CO_2	%	Kg CO_2	%	Kg CO_2	%
Transport from grower	1.428.179	34,5	1.808.231	35,6	1.974.892	35,3
Intermediate transport	281.161	6,8	371.905	7,3	486.989	8,7
Distribution transport	773.139	18,7	907.193	17,9	1.033.559	18,5
Business trips/meetings	113.846	2,8	144.357	2,8	186.094	3,3
Commuting	207.845	5,0	251.429	5,0	299.025	5,4
Energy incl. refrigerant	851.199	20,6	1.056.512	20,8	977.149	17,5
Packaging	438.985	10,6	461.180	9,1	521.996	9,3
Paper	42.205	1,0	74.453	1,5	107.494	1,9
Total	**4.136.558**	**100,0**	**5.075.259**	**100,0**	**5.587.198**	**100,0**

Next after transports, the two groups energy (incl. refrigerant) and packaging contribute the most to the CO_2 emission. To evaluate the mentioned groups more precisely, it is necessary to consider the exact results, which is done area by area in the following.

2.1 Transport of goods

Goods transport can be split into three parts; transport from grower, intermediate transport and distribution transport. Transport from grower includes the transport of fruit, vegetables, groceries and meat/poultry/fish from supplier to our package facilities at Barritskov and it contributes with more than 1/3 of the total amount of the CO_2 emission at Aarstiderne. This is the largest single post in the CO_2 accounts (**Table 2**).

Intermediate transport includes transport of boxes from packaging at Barritskov to one of the 9 distribution centers in Denmark and 4 distribution centers in Sweden, while distribution transport includes the final stage of the transport (from the regional distribution center to the customers doorstep). The intermediate- and distribution transport contribute with approx. 1/3 of the total CO_2 emission at Aarstiderne (**Table 2**).

All transport (from grower, intermediate and distribution) contribute with almost 2/3 of the total CO_2-emission and this area is clearly the largest contributor to the CO_2 emission at Aarstiderne.

Transport forms

Depending on the distance and the transport form, there is a big difference on the CO_2 emission, which is illustrated in **Figure 4**. During 2017, 14 truckloads times 15 tons goods have partially been transported by train, a transport form that has lower CO_2 emission compared to lorry transport. E.g. lorry transport from Italy emits 17 times more CO_2 than lorry transport within Denmark, while transport by train only emits 10 times CO_2 compared to lorry transport within Denmark. So the combination of lorry and train from Italy (Bari) emit 61 % of the CO_2 emission made by the tour from Italy by lorry alone. In the perspective of CO_2 reduction this transport form is very interesting.

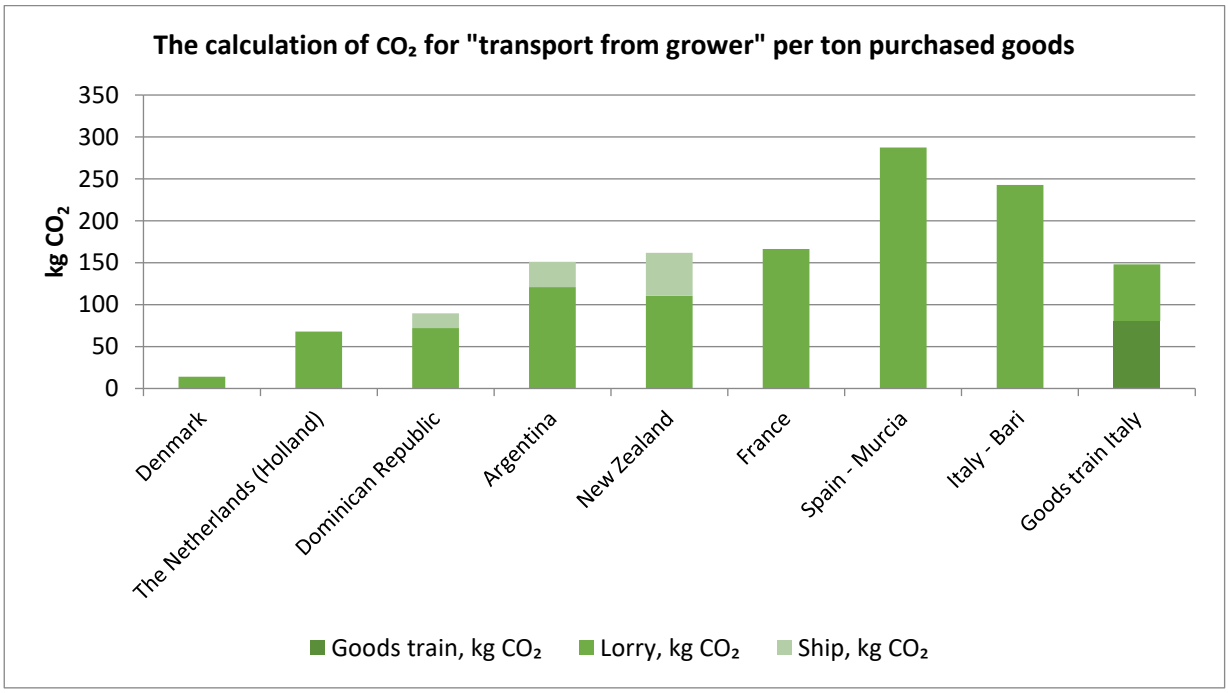

Figure 4. The calculation of CO_2 from "transport from grower" to Barritskov per ton purchased goods with different transport forms from selected countries.

In **Figure 4** a comparison is made, where two distances are driven by lorry, and the result shows that transport from Holland emit approx. 4 times more CO_2 as transport within Denmark. However, ship transport from Argentina, Dominican Republic or New Zealand (when the production is close at the harbor) make approx. the same CO_2 emission as lorry transport from France (Nantes). As earlier mentioned train transport is a very good alternative to lorry transport, but this is only possible if there is reliable train connections. Air transport emits large amounts of CO_2, so we never use air transport for the purchased goods (business policy at Aarstiderne). E.g. lorry transport emits 0.107 kg CO_2 per Ton*km, whereas air transport emits approx. 1.25 kg CO_2 per Ton*km.

Elaboration – kg CO_2 per drop and kg CO_2 per DKK 1000 generated from "transport from grower"

Measured by CO_2 per drop "transport from grower" is increasing through the period, though a small decrease is seen in 2015 and 2017 (**Figure *5***). These variations is probably the result of variations of Danish purchase the single year and variations in seasons from year to year.

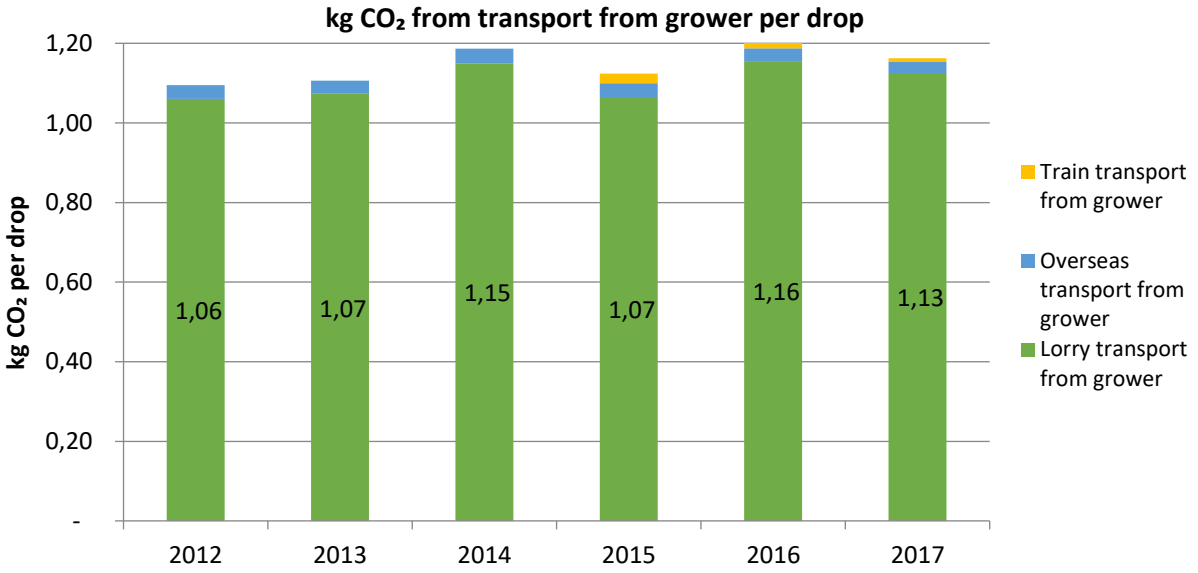

Figure 5. The contribution to kg CO_2 per drop for 2012-2017 from "transport from grower" with truck, ship and train.

Looking at the CO_2 emission per DKK 1000 generated in **Figure 6** the development is decreased during the period. The variations from year to year is mainly explained by the balance of the supply of organic fruit and vegetables from Denmark and Northern Europe versus the supply from the Southern part of Europe.

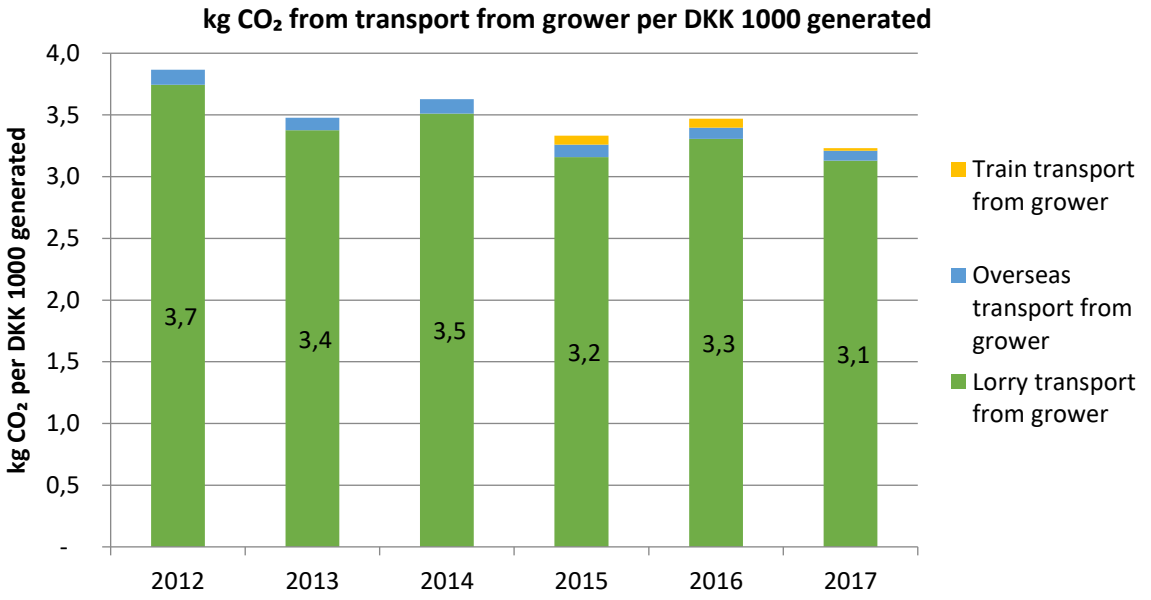

Figure 6. The contribution to kg CO_2 per DKK 1000 generated (in 2015 DKK) for 2012-2017 from "transport from grower" with truck, ship and train.

Train transport has decreased in 2017 compared with the earlier years. The reason is that a restructuring of the rail system is giving a longer transport time, which isn´t satisfying regarding our fruit and vegetables. This work is hopefully done within a year or two, so we can use this more *CO_2-* preferable transport form, especially for the goods from Italy. The development in relation to purchasing fruit, vegetables and meat from Denmark and fruit from Northern Europe is illustrated below.

Danish share

As seen in **Table 3** Danish fruit composes 6 % of total purchased fruit [tons] in 2017, whereas the Danish share of vegetables is 38.9 %, a number, which has decreased from 55 % in 2012. Within the share of fruit from Northern Europe (Danish & German) an increase is seen from 11 % in 2012 to 24.8 % in 2017, which mainly is a result of a large purchase of German apples from the area of Hamburg. The decrease in Danish share of vegetables is due to a lack of Danish organic vegetables owing to a high demand on the organic market, and probably a different composition of vegetables in the increasing amount of meal boxes.

The Danish share of purchased meat (beef, pork, lamb and chicken) [ton] was at 80 % in 2012, but has decreased to 60.3 % in 2017. This is due to increased use of organic chicken and turkey, which at the moment isn´t available with a Danish origin. However, the total tons of purchased Danish organic meat has increased from 122 tons in 2012 to 504 tons in 2017, primarily due to increased amounts of meal boxes sold at Aarstiderne.

Table 3: Danish Share of purchased fruit, vegetables and meat in tons & percentage of the total purchase for the years 2012-2017.

Danish share	2012	2013	2014	2015	2016	2017
Danish fruit [tons]	341.7	312.0	207.3	301.0	287.0	181.1
Danish share of fruit [%]	10.5	9.9	6.5	9.1	7.8	6.2
Northern European (Danish & German) fruit [tons]	356.3	525.1	385.6	741.7	679.2	721.7
Northern European (Danish & German) Share of fruit [%]	11.0	16.7	12.2	22.4	18.4	24.8
Danish vegetables [tons]	1,697.1	1,642.0	1,693.1	2,222.3	2,278.0	2,710.3
Danish share of vegetables [%]	55.5	47.0	40.7	41.4	34.5	38.9
Danish meat [tons]	122.3	173.0	239.5	383.8	510.9	503.8
Danish share of meat [%]	80.0	71.2	67.2	70.0	65.5	60.3

2.2 Transport of personnel

The transport of personnel is composed of business trips incl. business transport in own car (figure 7), air transport and overnight stays in relation to business meetings (figure 8) train transport (figure 9) and the employees commuting to Aarstiderne (figure 10). Business trips and commuting compose more than 3 % and 5 %, respectively of the total CO_2 emission in 2017, where the largest contribution came from air transport and company cars.

Business trips

An increasing activity and an increasing number of employees are reflected in an increasing use of company cars, air transport and overnight stays. However, only overnight stays are increasing as much as the turnover during the period. The number of train trips declined during the years, but a small rise is seen from 2016 to 2017. In 2014 Aarstiderne bought a Tesla electric car, which has resulted in a CO_2 reduction from company cars, as an electric car emits 60% of the emission of a diesel company car.

As seen in **Figure 7** kg CO_2 emitted from transport using company cars and business trips in employee owned cars has increased from 2014 to 2016, but it stagnates from 2016 to 2017. The use of company cars are declining a bit from 2016 to 2017, whereas work related transport in own cars are rising.

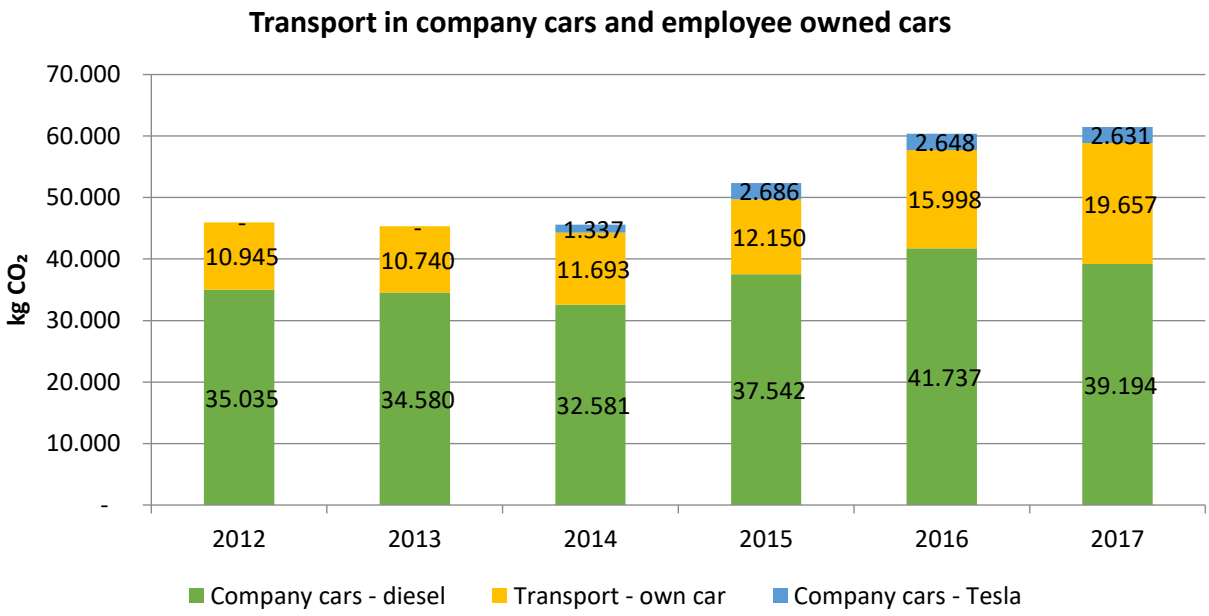

Figure 7. kg CO_2 emitted regarding business trips in company cars (diesel or electricity) or employee owned cars.

According to **Figure 8** kg CO_2 emitted from air transport has increased during the entire period, except for the decline seen in 2015. Likewise, kg CO_2 emitted from overnight stays at hotels has increased from 2012 to 2016, followed by a small decrease from 2016 to 2017. Regarding train transport (**Figure 9**), the highest number of train trips and thereby CO_2 emission was seen in 2012. In 2013 a large decline is seen, followed by an increase until 2015. This form of transport is used much less the last two years (2016 and 2017) compared to earlier years.

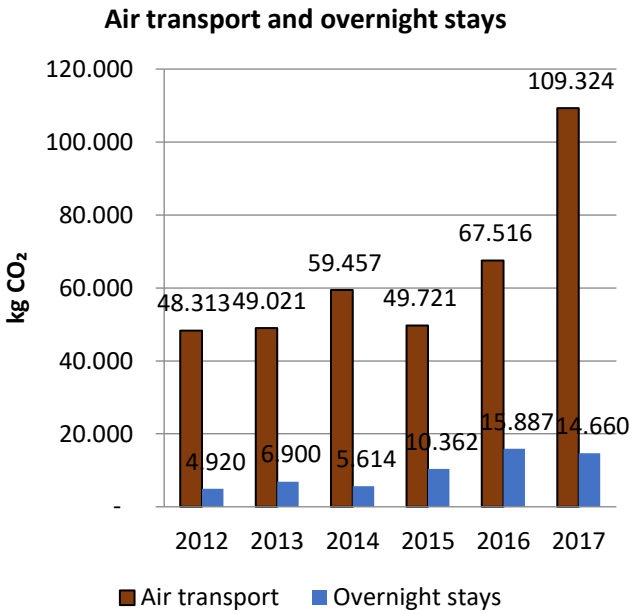

Figure 8. kg CO_2 emitted from air transport & overnight stays regarding meetings and business trips.

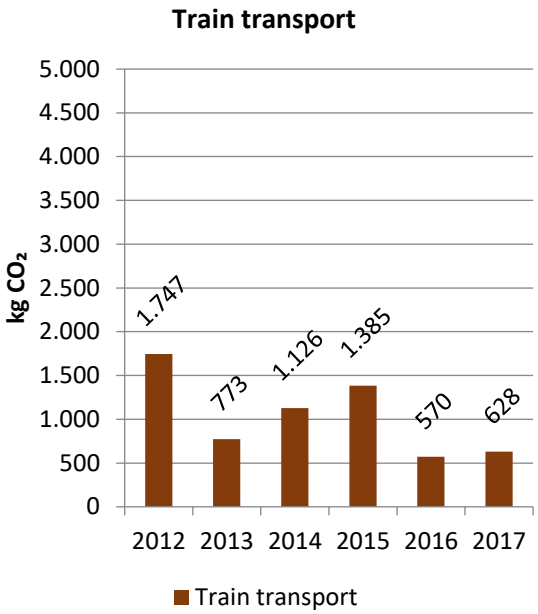

Figure 9. kg CO_2 emitted from train transport in relation to meetings and business trips.

Commuting

Commuting is estimated as a simple multiplication of the full-time employee number with the transportation model, obtained by questionnaire survey among employees in 2015 (use for 2012-2016 calculations) and a new survey (used for 2017 calculations). The development of commuting follows the number of employees (**Table 4**).

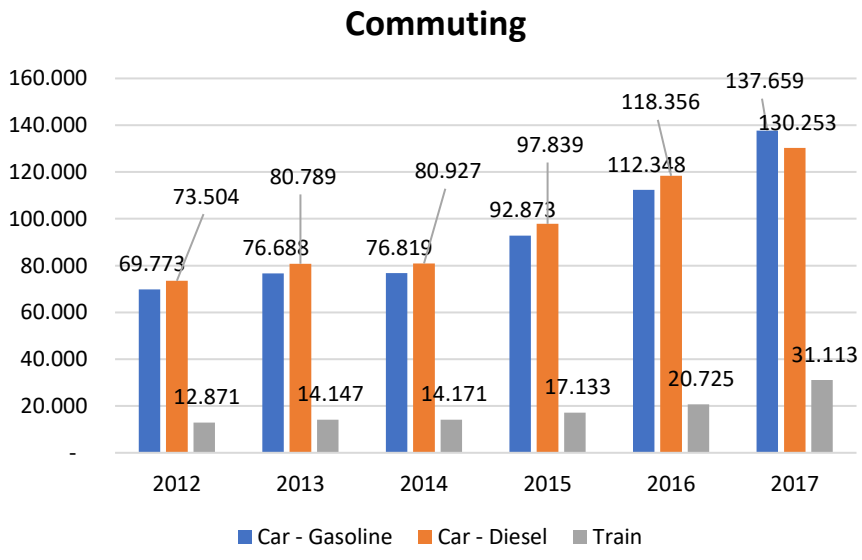

Figure 10. The commuting regarding transportation of employees at Aarstiderne - kg CO_2 emitted from commuting with different transport forms for the period 2012-2017.

Table 4. Overview of the development regarding number of full-time employees in Aarstiderne from 2012 to 2017.

Year:	Full-time employees [number]:
2012	111
2013	122
2014	128
2015	154
2016	189
2017	224

2.3 Energy consumption

More than 17 % of total CO_2 emissions at Aarstiderne was emitted from energy consumption, of which electricity consumption for cooling was the major factor. According to **Figure 11** CO_2 emitted from electricity consumption has strongly increased in the period 2012-2017 due to a larger storage area with cooling systems. Oil consumption has decreased since 2013, mainly due to a new gas-fired boiler at Krogerup and a wood-fired boiler at Barritskov have been installed. CO_2-emission from refrigerant was high in 2015 and 2016 due to a leak and refilling of new cooling systems, furthermore an ice machine have had some technical issues in 2017. CO_2-accounts from LPG gas used in kitchen and for forklift trucks are illustrated in appendix A (**Figure 21**), as the CO_2 emitted from LPG gas (around 5000 kg) is very small in relation to the other items in the figure below.

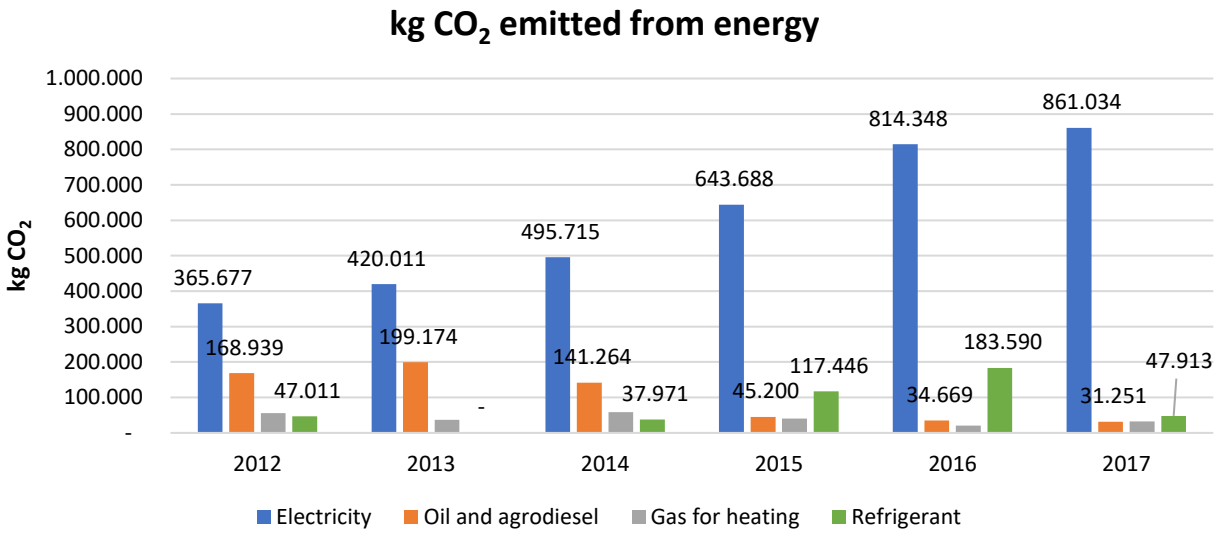

Figure 11. Kg CO2 emitted from energy (electricity, oil, gas and refrigerant) for the period 2012-2017.

Elaboration – kg CO_2 per drop from energy

The emission of kg CO_2 per drop from energy consumption is declining from 2013 to 2017, except a small increase in 2016 due to rebuilding and larger facilities, and thereby a higher consumption of electricity than previous years (**Figure 12**).

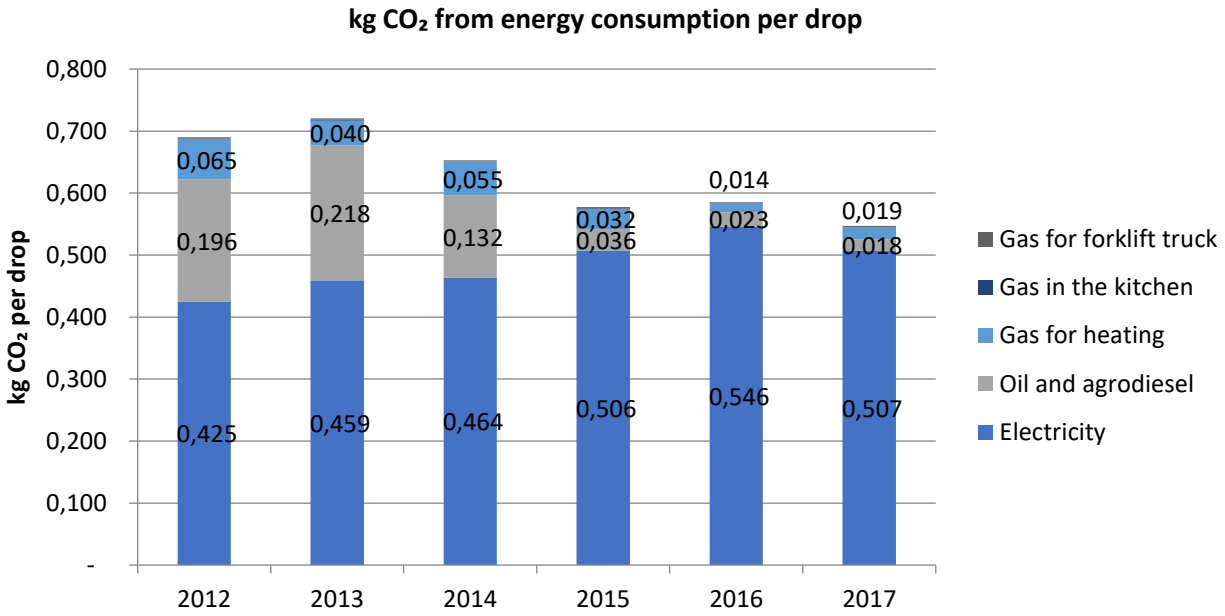

Figure 12. kg CO_2 per drop emitted regarding consumption of electricity, gas and oil to cooling, light, heating, forklift trucks and cooking in the kitchen in the period 2012-2017.

Elaboration - Electricity and Oil consumption

As earlier mentioned a major reduction in oil consumption took place from 2014 to 2017 due to installation of two new boilers in 2014 and 2015, respectively. The result of the 2 investments is illustrated in **Figure 13**.

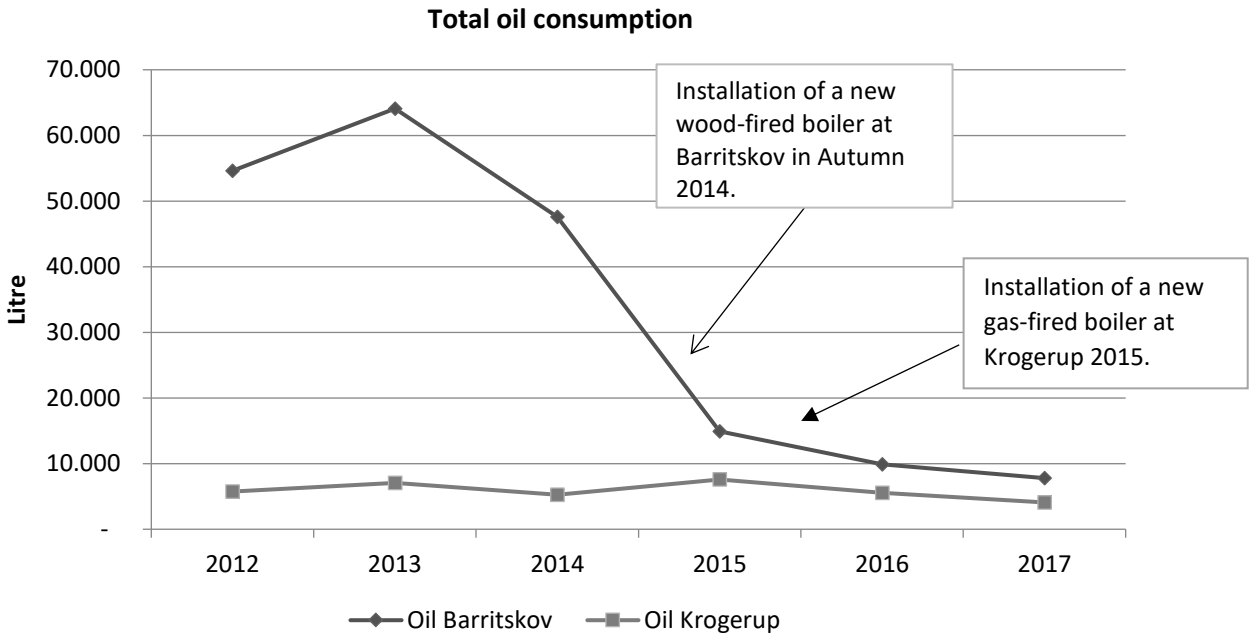

Figure 13. Total agrodiesel/oil consumption [Liter] for Barritskov & Krogerup, respectively in the period 2012-2017.

The consumption of electricity has increased at Barritskov, Krogerup and at the external distribution centers, where the establishment of a separate packing facility and expansion of the external distribution center in Avedøre (called Hammerholmen) contributes to the increase. The higher consumption at Barritskov in 2016 is primarily due to rebuilding of packing facilities, while the higher consumption at Krogerup in 2015 is due to the installation of two cooling containers. The higher electricity consumption in Hammerholmen (Avedøre) in 2017 is a result of an expansion of storage facilities with cooling systems installed.

Furthermore, the electricity consumption at the external distribution center in Aarhus and Bjæverskov is added for 2016 and 2017 under the calculation of total electricity consumption (**Figure 14**).

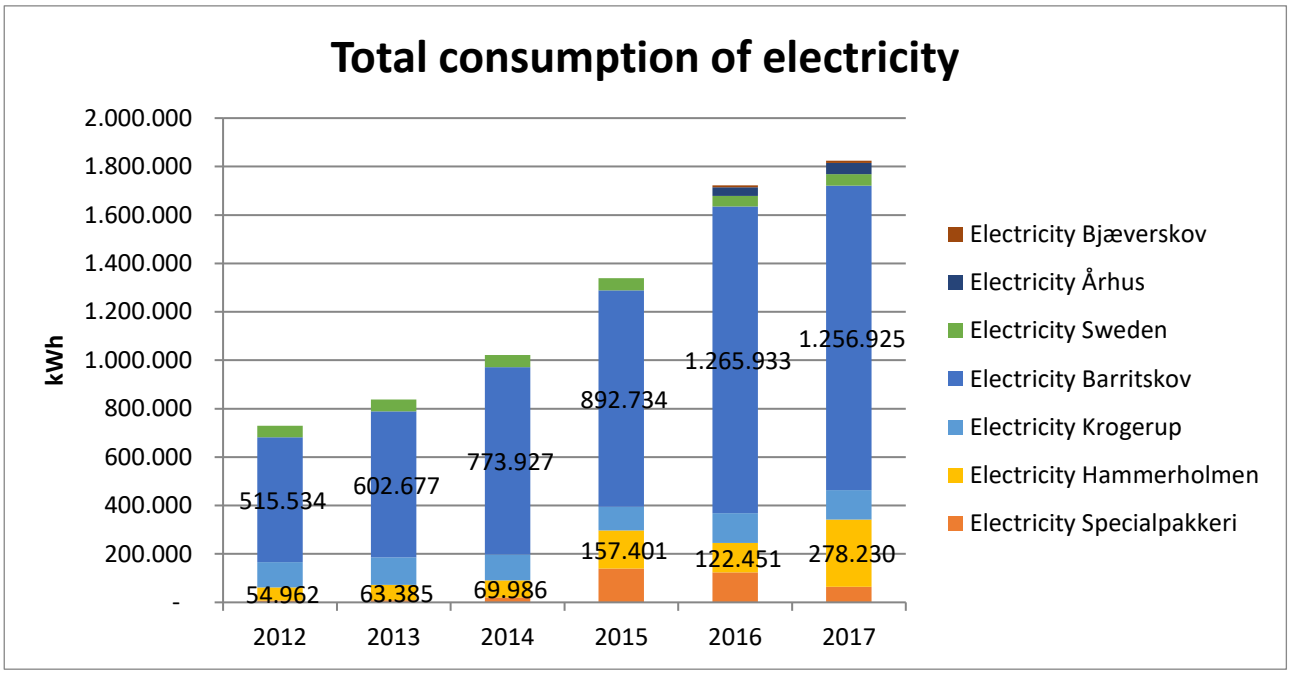

Figure 14. Total electricity consumption [kWh] for Bjæverskov, Århus, Barritskov, Krogerup, Hammerholmen (Avedøre) and Sweden in the period 2012-2017. NB! Bjæverskov and Aarhus only in 2016 and 2017.

2.4 Refrigerant

The consumption of refrigerant leads to a relatively large CO_2 emission in some of the years, where a refilling of refrigerant has been necessary due to a leak and installation of a new cooling system. Especially HFC is a strong greenhouse gas and so contributes considerably to CO_2 emissions in 2015. A leak in the refrigeration system in 2015 gave a relatively large CO_2 emission corresponding to two times the annual oil consumption or more than the total CO_2 emission from company cars and flights the same year. In 2016 a huge CO_2 emission was seen, as new refrigeration systems were installed and filled up with R404A/R744 at Barritskov, just like a leak is seen in 2017 due to repair of ice machines at Aarstiderne (**Figure 15**). The refrigerant in the cooling systems at Aarstiderne was earlier predominantly Freon, but in the end of 2017 and the early 2018 the old cooling system was replaced by a new, which work with CO_2 as refrigerant.

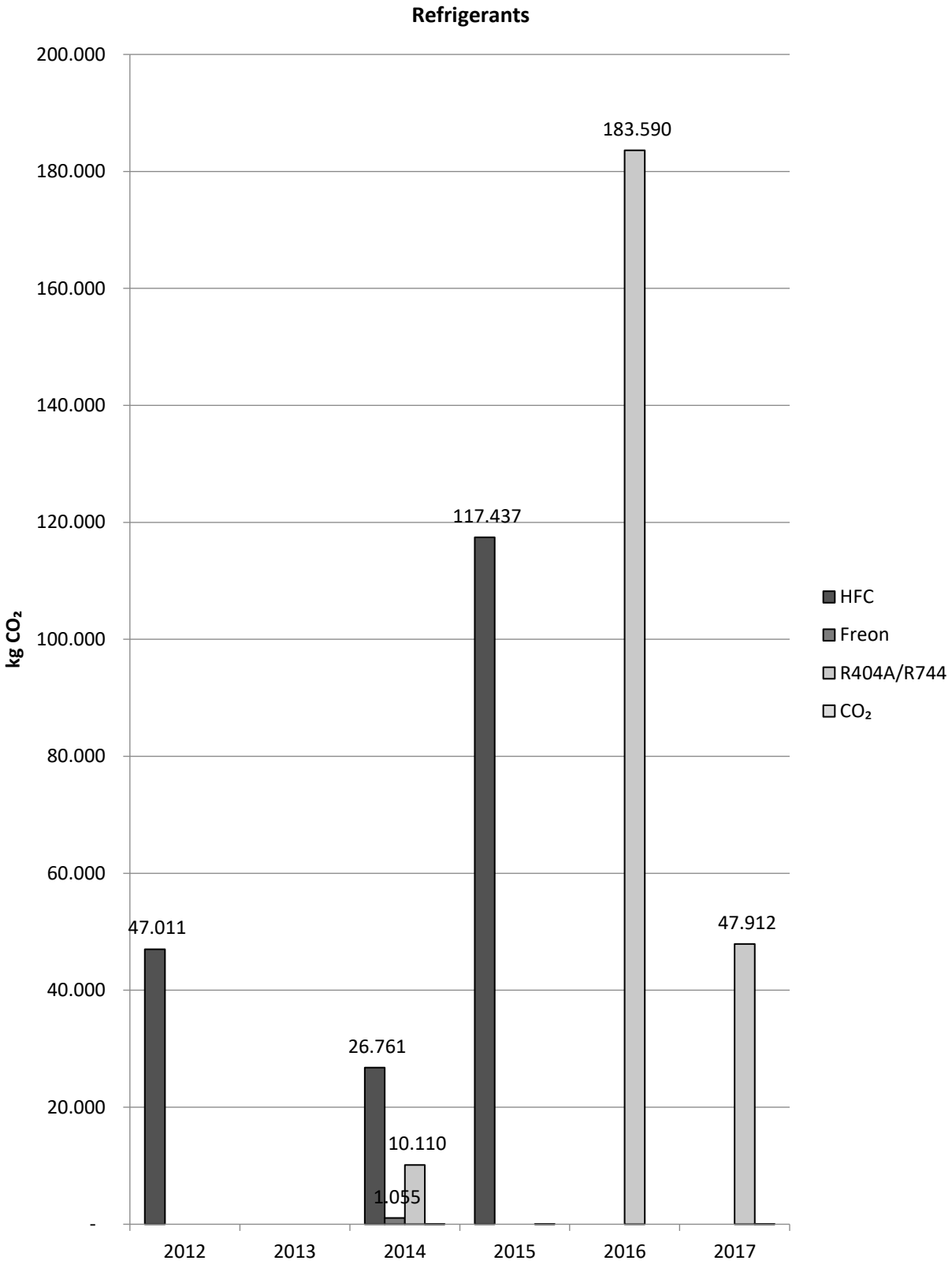

Figure 15. kg CO_2 emitted from refrigerant (HFC, Freon, R404A/R744 & CO_2) in the period 2012-2017.

2.5 Packaging and paper

The well-known iconic boxes from Aarstiderne has been involved from the very beginning, and it is a part of our brand. The boxes are made of wood and thereby it isn´t included in the CO_2-accounts, as it is considered as a renewable resource. But the inliner (the plastic bag inside the wood box) is a part of the CO2-accounts, as well as the EPS foam boxes are a part of these calculations. During 2012-2017 the CO_2 emission from packaging and paper has been 10-14 %, and the major single factor in this group has been the inliner plastic and the EPS foam boxes.

EPS foam boxes

UV-light disinfection of EPS foam boxes makes it possible to recycle the EPS foam boxes, which has given a considerable reduction in the use of new EPS foam boxes, as 784.594 boxes of EPS foam in 2016 were treated, which reduced the number of purchased EPS foam boxes, and thereby a reduction in CO_2 emission in 2016 from this material than previous years (**Figure 16**). In 2017 the purchased number of EPS foam boxes increased, but the average reuse was also increasing - from 3.3 times in 2015 (3.9 times in 2016) to 4.2 times in 2017, before they were discarded.

Inliner

As mentioned earlier the wood boxes are provided with this plastic bag, called an inliner. The consumption of inliners has increased during the period, but the use has been irregular. It could be due to unclear cut off in storage numbers for inliners (**Figure 16**). Flowpack plastic has replaced the packaging task from the plastic cups, which lead to less CO_2 emitted, even though the turnover and thereby production has increased the CO_2 emission has been at the same level. In 2017 the CO_2 emission from flowpack plastic is larger than the earlier years, which can be due to our experiments with different plastic types as a plan to optimize the packaging materials.

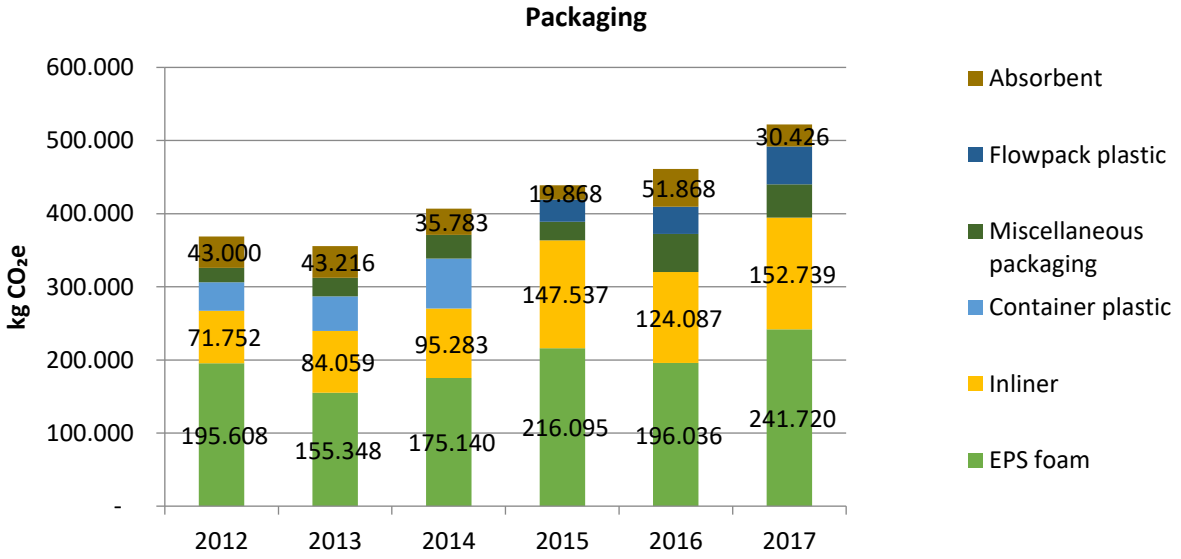

Figure 16. kg CO_2 emitted from packaging (absorbent, flowpack plastic, miscellaneous packaging, container plastic, inliner and EPS foam boxes) in the period 2012-2017.

Paper

With regard to paper consumption, a change in format (from a 3-page newsletter to a flyer) resulted in a minor reduction in the total amount of printed paper, which lead to a decline in CO_2 emission from paper. Furthermore, Aarstiderne switched to cradle-to-cradle (C2C) paper, with improved environmental properties, at least FSC-paper but often with EU Eco-label as well. However, we have today no assurances that C2C emits less CO_2 than other types of paper. Within the calculations for 2016 and 2017 printed papers used during campaigns are included as new items, therefore a column for campaigns is seen below in **Figure 17**.

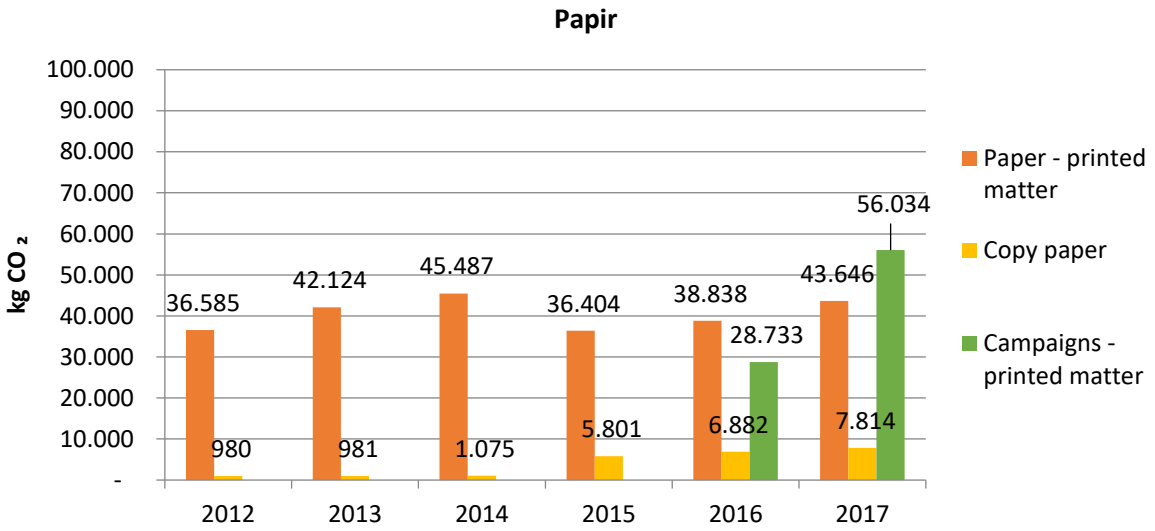

Figure 17. kg CO_2 emitted from paper consumption to newsletter, recipes and various paper use in the period 2012-2017.

For further information see appendix A regarding additional figures and appendix B according to the used emission factors from CONCITO.

3.0 Methodology

System boundaries

In this report we have attempted to take the temperature of Aarstiderne´s total CO_2-emission. However, certain boundaries have been set up along the way, which influence the outcome.

In certain cases the figures are based on an assumption of stability. This includes items such as distribution transport, whereby a sample was taken in 2015, and for commuter transport, for which a questionnaire survey was handed out in 2015 and 2018, respectively. Paper for newsletters and recipes is difficult to set a precise CO_2 account on, as the actual paper can be produced on new or recycled paper fibers from more or less sustainable resources and at the same time the machines and the ink, that are used to print, are a much more important part of the CO_2 footprint. The recipes are printed internally, but are not included in relation to ink and machine usage. Moreover, a precise calculation of other printed matter (e.g. information material) and distributed advertisement material to homes has not been made for 2012-2015. In 2016 and 2017 the printed matters for advertisement campaigns have been included in the accounts of paper use.

The CO_2 footprint is calculated using data collected from when the goods leave the suppliers gate to when they arrive at the customers front door. Therefore, the primary production and suppliers resource usage (e.g. packaging material) has been left out of the calculations. Furthermore, a small number of boxes are packed on the farms, (e.g. “The Kisel Box”), thus drawing on these external resources, which are not included here. Carriage of materials, that are part of the production, has not been included in the calculations as well. Wholesalers in many cases get there goods from all over the world, so the point of origin of these goods is assumed together with the wholesalers as the most probable origin. For example all dried spices are assumed coming from Thailand. All processing operations at dairies, juice companies, spice packers and likewise processing is considered part of the primary production and is not calculated in this report. Finally, farming at Barritskov and Krogerup is not included (e.g. the test fields – manpower and machine use), but the use of agrodiesel at both farms are included.

Method of accounting

Data for the statements are coming from different sources. Here's an overview of the different groups:

- Transport from grower - Actual purchase with standard distance for each country
- Intermediate transport – The number of pallets to each destination is estimated for the period 2012-2015, and the data for 2016 and 2017 are collected from the ERP-system
- Distribution - 22 routes measured in December 2015 as basic route lengths
- Company cars - Metered consumption with standard diesel consumption
- Air transport - Travel route with standard travel distance
- Train trips - Known trips are calculated and the rest are estimated
- Accommodation - Number overnight stays and calculated at a standard rate
- Commuting – Questionnaire surveys from 2015 and 2018: result used as a basis X full time employee
- Electricity – Exact use stated by the power plant and the ERP-system at Aarstiderne
- Oil, gas, LPG & Refrigerants – Exact purchase (Data from the ERP-system at Aarstiderne)

- Packaging - Stocked items (ERP-system)
- Paper - Newsletters and recipes multiplied with sold boxes to calculate the paper consumption and campaigns printed matters (ERP-system)

Key figures (e.g. number of tons*km for transport from grower) has been calculated for each individual category, which makes it possible to calculate the amount of CO_2 emitted in kg based on CONCITOs emission factors. A more detailed method of description for each individual post has been made in a separate report.

Corrections

CO_2 emitted from work related transport in the employees own car was excluded in the earlier reports (2012-2015), but the calculations are included for all years (2012-2017) in this report and the previous one.

By investigating the commuting calculations from the questionnaire survey in 2018, the model of commuting calculation was changed. The have been incorporated for the whole period. So now the commuting area contributes with higher amounts than in earlier reports.

Furthermore, agrodiesel have been included into the CO_2-accounts for 2012-2017 under oil consumption, which it haven´t been in the previous versions of the report.

During the preparation of this report we reviewed the data for 2015 and some of the assumptions regarding countries of origin were changed, which has led to more accurate data. The same facts have been used for 2015, 2016 and 2017, respectively.

Included in this report (2012-2017) is flowpack plastic used for packing the processed foods. The plastic previously used for processed foods was phased out in 2014, and since 2015 flowpack has replaced the other packaging material and is for the years 2015-2017 added under the category packaging. At the early 2018 new packaging materials - bioplastic - are introduced in our new investment “The green kitchen”. These bioplastic cups are included in the next CO_2-account. The emission from use of absorbents (The product sucking water from melting ice in EPS foam boxes) are also included for all years 2012-2017 in this CO_2 report.

For the next version the stock inventory in relation to packaging materials is probably a good item to check out, as we haven´t been able to find a correlation between turnover/production and packaging use.

4.0 Summary

Since 2012 Aarstiderne has experienced increasing sales. The growth has induced rebuilding, larger cooling facilities and change in the product combination. The rebuilding and expansion of the distribution center "Hammerholmen" in Avedøre has influenced the CO_2 emission for 2017. Furthermore, a still larger sale of meal boxes and more goods per drop at each door step affects the total CO_2 emission for 2017 at Aarstiderne.

The total CO_2 emission is dominated by the transport of goods, as it contributes with 2/3 of the total CO_2 emission at Aarstiderne. "Transport from grower" is without any doubt the largest item and contributes with more than 1/3 of the total CO_2 emission. The contribution from the intermediate transport has increased in 2016 and 2017 compared to the previous years. This is due to improved registration, where the exact intermediate transport is measured. In previous years, parts of the intermediate transport were estimated. A minor increase of CO_2 emission per DKK 1000 generated from "transport from grower" was seen from 2016 to 2017. Might be due to different geographical distribution of the purchase from year to year. The percentage of Danish vegetables has increased from 34.5 % in 2016 to 38.9 % in 2017.

Energy is also a large item in the CO_2 accounts, as it contributes to more than 17 % of the total CO_2 emission, which is relatively smaller than the previous years. The development is a combination of a decrease in oil and gas consumption and an increase in electricity consumption during the period, primarily due to introduction of larger facilities with cooling systems installed.
The CO_2 emission from refrigerants is expected to be zero, unless a new cooling system is installed (like the case in 2016 at Barritskov) and filled up with refrigerant, or a leak (like the case in 2015). The refill in 2017 was related to problems with our ice machines. An investment has been done in spring 2018, where the cooling systems at Barritskov in the future use CO_2 instead of toxic and polluting refrigerants used presently.

The total consumption of packaging and hereby kg CO_2 emitted from packaging has increased from 2013 to 2017. In 2017 an increase is seen, primarily due to higher amount of inliner and EPS foam boxes purchased, even though more EPS foam boxes also have been reused.

2012-2017:
25 % decline in kg CO_2 emitted per DKK 1000 generated.
5 % decrease in kg CO_2 emitted per drop.

Transport:
62,5 % of total CO_2 emission in 2017.

Transport from grower:
More than 35 % of total CO_2 emission in 2017.

Danish Share of purchase:
Fruit (6 % in 2017).
Vegetables (39 % in 2017).
Meat (60 % in 2017).

Energy:
More than 17 % of total CO_2 emitted in 2017.

Oil and Gas consumption has decreased in the period 2012-2017.
Electricity consumption has increased from 2012-2017.
Refrigerant – leak in 2015 (117 tons CO_2) & new refrigeration equipment in 2016 (183 tons CO_2) and ice machine issues in 2017.

Packaging:
More than 9 % of total CO_2 emitted in 2017.

Commuting was calculated per employee according to a basis of distribution (result of the two questionnaire surveys), and hereby the emission increased as the number of employees increased. Air transport contributed the most to CO_2 emission in the group "Business trips", and the emission has increased in 2017 due to more activity in relation to business meetings and trips. Transport in company cars or employees own cars contributes with a significant CO_2 emission as well.

Regarding paper, the consumption and CO_2 emission from paper increased during the period. Furthermore, printed materials used during campaigns were included in the numbers for paper consumption in 2016 and 2017, which wasn´t included in the previous years.

Generally, the total CO_2 emission (kg CO_2 emitted per DKK 1000) has decreased during the period. Nevertheless, it is obvious to improve items at Aarstiderne, which influence the CO_2 emission by optimizing different focus areas, such as increasing the percentage of Danish vegetables and fruit (result in less lorry transport), increasing train transport (emits only 61 % of the emission from lorry transport), optimizing the consumption of electricity, use of better refrigerants and finding clever ways to use less packaging or recycle more.

Business trips and commuting:
Business trips and commuting contribute with more than 3 % & 5 % of total kg CO_2 emitted, respectively.

Paper:
Barely 2 % of total CO_2 emitted in 2017.

2012-2017:
Total amount of kg CO_2 emitted per DKK 1000 generated (in 2015 DKK) has decreased during the period, but a small rise in 2016.

Possibilities for future improvements

Finally, a brainstorm is made to find possible improvements to decrease the CO_2-emission at Aarstiderne by investments at certain areas. The effect on the CO_2-emission is estimated, and as seen below the different improvements are only capable of decreasing the CO_2-emission a bit each. Some changes Aarstiderne are fully responsible for and can easily affect, if the technical and economic conditions are present. Other factors, such as the transportation area, is difficult to change overnight.

Table 5: Possible focus areas, actions and approx. decrease in total CO_2-emission at Aarstiderne by improvements and investments for the future (brainstorm).

Focus area:	**Action:**	**Approx. decrease in total CO_2-emission:**
Transport from grower	15 % of goods from Italy/Spain purchased from Denmark instead	1.0 %
Intermediate transport	The hub being 50 km nearer to the customer for 25 % of our customers (Lorry replacing km with vans)	0.5 %
Intermediate transport	Our own lorry is replaced by an electrical lorry driving 600 km per day, 7 days a week, 52 weeks per year	3.3 %
Distribution	Electric vans on all routes	7.0 %
Company cars	Tesla or electric cars for all	0.3 %
Refrigerant	All refrigerants is converted to CO_2	2.0 %
Packaging	Recycling factors rises from 4 to 5	1.0 %
Paper	Newsletters and recipes go digital	0.4 %

These estimations (**Table 5**) show that substantial reductions regarding the CO_2-emission need a specific effort in more areas than one in the near future at Aarstiderne.

5.0 Appendix A – Additional figures

Even though the total energy consumption increases heavily together with the rebuilding, it isn´t reflected, when the CO_2 emission is expressed per drop or per DKK 1000 generated. The tendency is quite the reverse, as the CO_2 emission from energy is decreasing (**Figure 18**), because the increase in electricity consumption almost was negated by a major decrease in oil consumption and natural gas for heating.

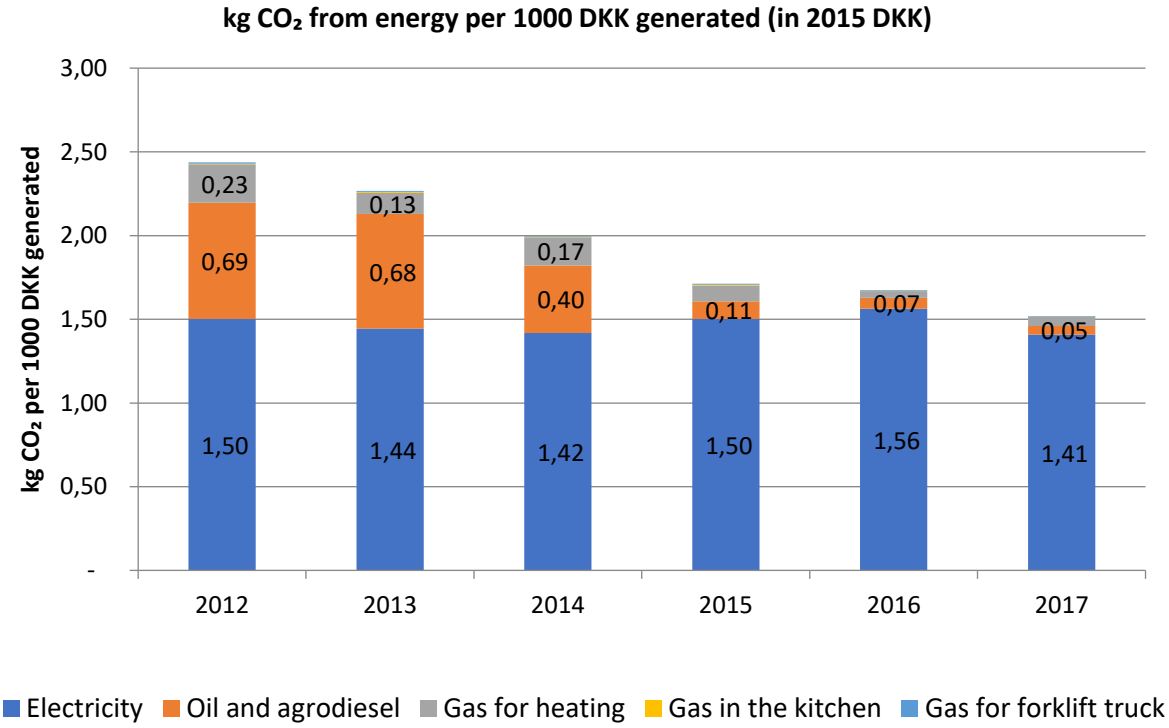

Figure 18. kg CO_2 per DKK 1000 generated (in 2015 DKK) emitted from consumption of electricity, gas and oil for cooling, light, heating and kitchen/trucks in the period 2012-2017.

According to **Figure 19** CO_2 emitted from electricity consumption has strongly increased in the period 2012-2017 due to a larger storage area with cooling systems.

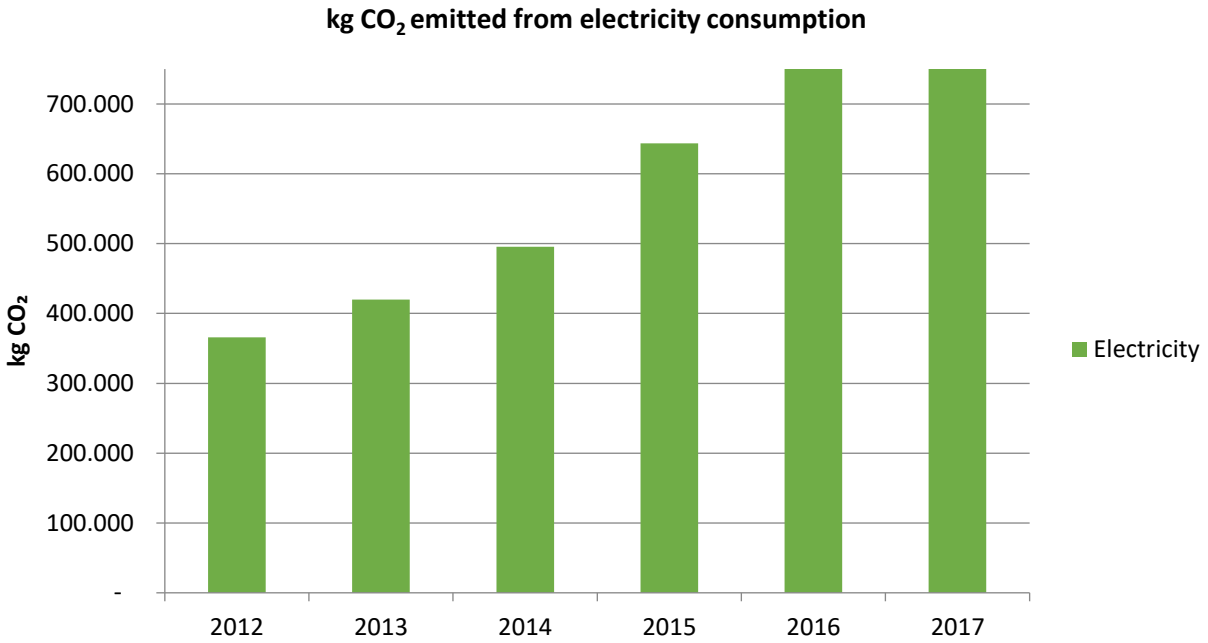

Figure 19. kg CO_2 emitted from the total consumption of electricity during the period 2012-2017.

Since 2013 the consumption of oil has decreased and now makes up a declining portion of the CO_2 emission.

In **Figure 20** a major decline in oil consumption for 2015 is seen, which is due to a new wood-fired boiler at Barritskov in Autumn 2014 and a new gas-fired boiler at Krogerup in 2015. The gas consumption used for heating is reduced since 2014, and now it only represents a tiny part of the total CO_2 emission.

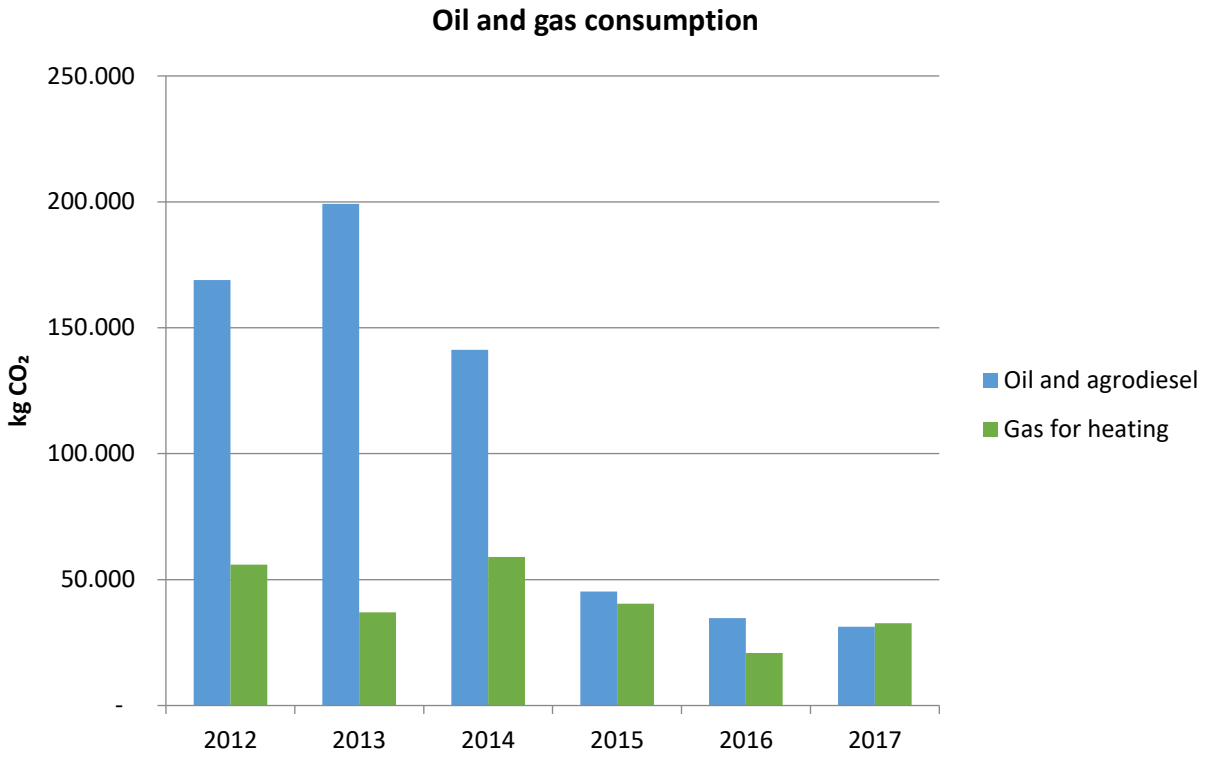

Figure 20. kg CO_2 emitted from gas for heating and agrodiesel/oil consumption during the period 2012-2017.

In **Figure 21** the consumption of LPG for the kitchen and forklift trucks is seen, and the consumption increased from 2016 to 2017. Overall, the gas consumption contributes with a tiny percentage of the total CO_2 emission.

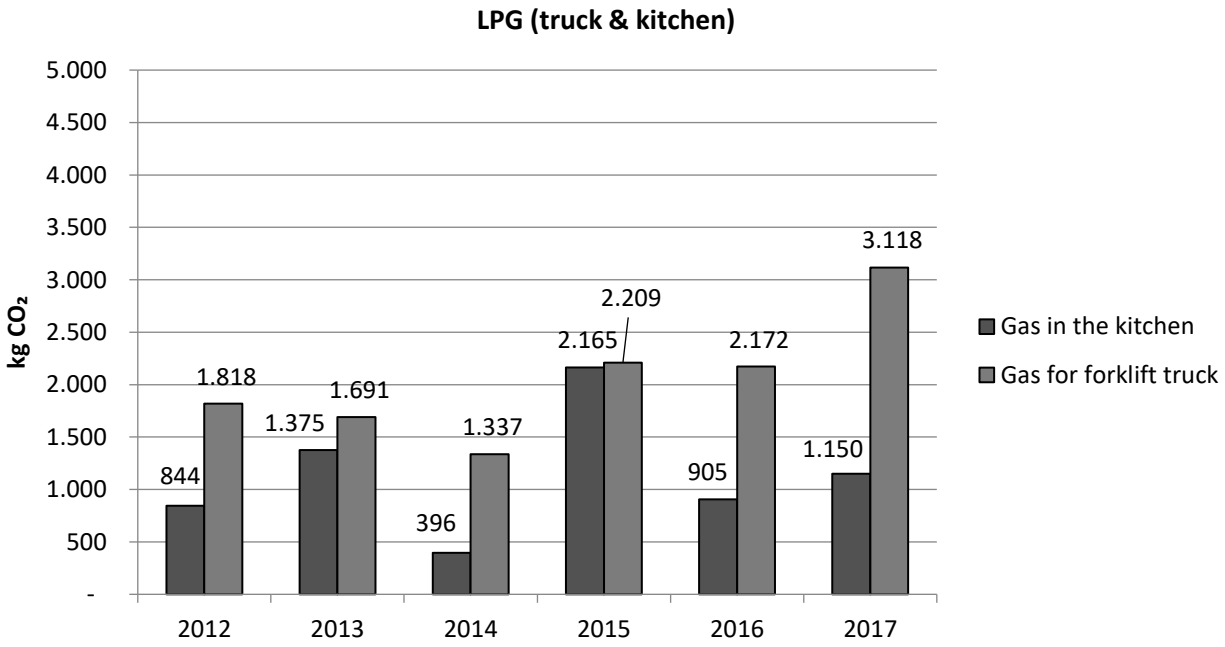

Figure 21. kg CO_2 emitted from LPG, used in kitchen and for forklift trucks in the period 2012-2017.

In **Figure 22** the result from the two questionnaire surveys regarding commuting is shown. Km with different transport forms, which the employees at Aarstiderne are using, is illustrated, and the km is increasing as the employees are increasing.

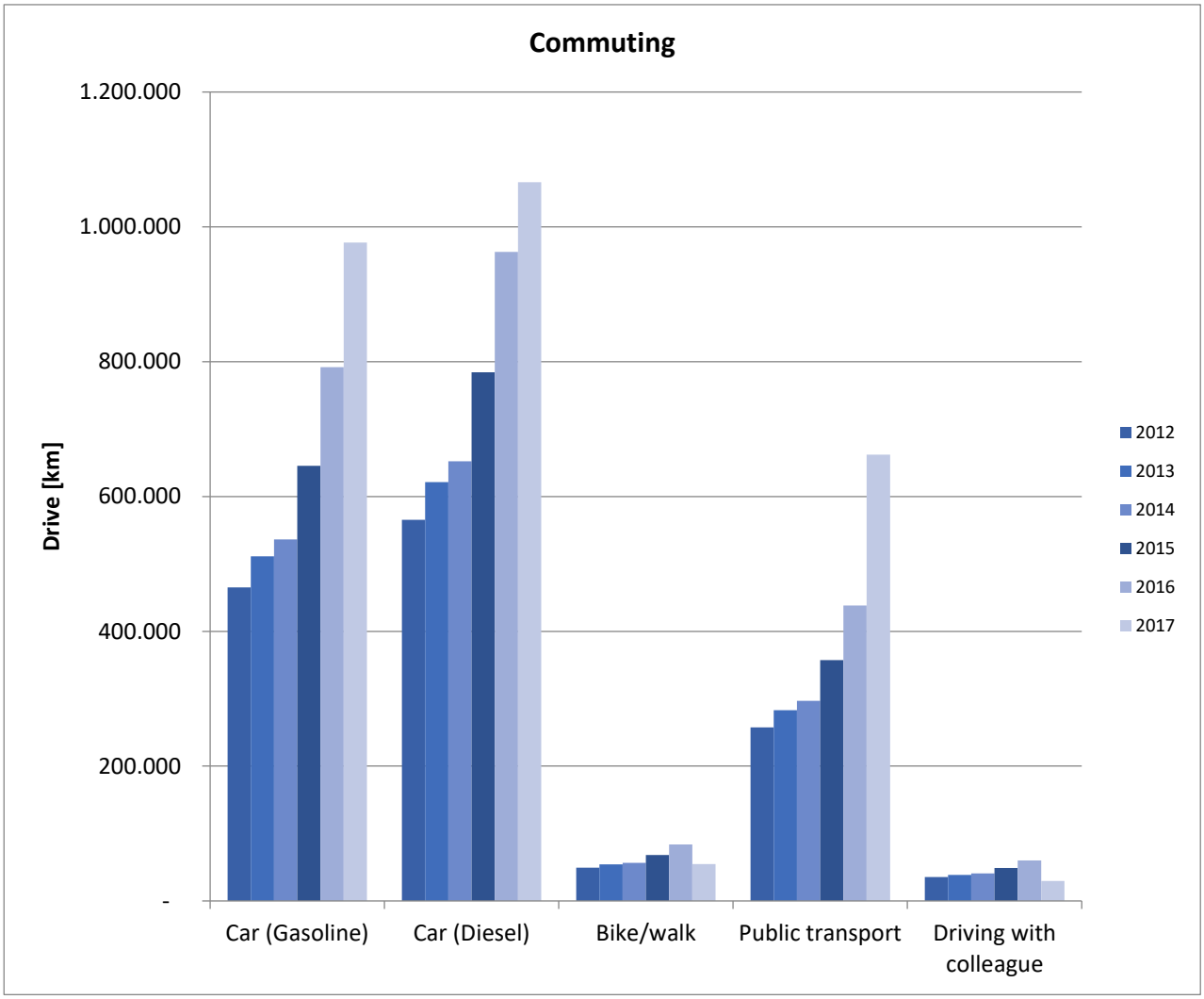

Figure 22. Total amount of km in different transport forms for all the employees at Aarstiderne (result from the two questionnaire survey in 2015 and 2018 – used as a distribution plan).

AARSTIDERNE

6.0 Appendix B – Emission factors

During the report the CO_2 emission factors (from CONCITO) shown in **Table 6** have been used to calculate CO_2 equivalents (CO_2 emission) from different materials or transport forms.

Table 6. Overview of emission factors (from CONCITO) used to calculate the CO_2 equivalents for all the different materials and matters for transport, commuting, energy, packaging and paper.

Emission factors (from CONCITO)		
Transport:	**kg/unit**	**Description:**
Transport from grower - lorry and intermediate transport - lorry	0.107	Lorry > 32 ton [ton*km]
Transport from grower - overseas	0.00243	Ship transport [ton*km]
Transport from grower - train	0.05	Train [ton*km]
Distribution transport	0.28	Delivery van [km]
Company cars - diesel	0.13	Car [km]
Company cars - Tesla	0.08	Electric car [km]
Air transport	250	Flight [per hour/passenger]
Overnight stays	60	Hotel [per night]
Train transport	0.05	Train [km]
Transport - own car	0.14	Car (average of diesel and gasoline) [km]
Commuting:	**kg/unit**	**Description:**
Car - Gasoline	0.15	Car [km]
Car - Diesel	0.13	Car [km]
Train	0.05	Train (person) [km]
Energy:	**kg/unit**	**Description:**
Electricity consumption	0.50	Electricity consumption [kWh]
Oil consumption	2.80	Oil for heating [L]
Gas for heating	2.20	Natural gas [M3]
Gas for the kitchen and forklift truck	2.90	Bottled gas [kg]
Refrigerant - HFC	1774	HFC [kg]
Refrigerant - Freon	1300	Freon [kg]
Refrigerant - R404A/R744	3922	R404A/R744 [kg]
Refrigerant - CO_2	1.00	CO_2 [kg]
Packaging:	**kg/unit**	**Description:**
EPS foam	3.50	Polystyren [kg]
Container plastic	4.40	Polypropylen [kg]
Inliner, flowpack, cup labels and other labels	3.07	HDPE (high density polyethylen) [kg]
Cellophane and transfer oil	2.50	LLDPE (Polyethylen) [kg]
Strapex	4.20	Polypropylen [kg]
Carrying tray and bag with handles	0.30	Recycle pulp [kg]
Absorbent	2.01	30 % Polypropylen & 30 % polyethylen
Paper:	**kg/unit**	**Description:**
Paper - printed matter	1.30	C2C paper [kg]
Copy paper	0.82	C2C paper [kg]