FREMTIDENS BÆREDYGTIGE PRODUKTION

INDUSTRIENS FOND

ATV Akademiet for de Tekniske Videnskaber

BASELINE 2022

Transition towards a more sustainable Danish production industry

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PREFACE

The ambition for this baseline is to consolidate the concept 'sustainable production' and create a common data-based language that can enable the industry to join the conversation. Only in this way will we, in a meaningful way, be able to discuss both opportunities and challenges in a context relatable to the daily lives and realities of various enterprises. As we will demonstrate, we see great potential for both individual enterprises and for Denmark.

Sustainable production is not a concept with a precise and generally accepted definition. There are pros and cons of the various definitions that are in the running for becoming the standard. We have chosen the availability of data as a guiding principle for our definition and, in the process, also consulted a number of leading experts, industry organizations and industry representatives.

Against this background, we have defined five effect indicators – resource consumption; water consumption; energy consumption; CO2 emissions; and waste generation – which introduces an understanding of sustainability that is broader than the climate agenda but, at the same time, is focused and for which we could obtain authoritative data from Statistic Denmark (the national bureau of statistics).

This baseline enables us to go from discussing sustainability to actually measuring it. We believe that this is the starting point for a factual, unbiased and prolific debate on how the Danish manufacturing industry can become more sustainable. Our focus on sustainability is not only for the sake of nature and climate; we are also concerned about competition, growth, welfare and Danish workplaces. Sustainable production will help us combat climate change and improve biodiversity, and it will also be a potential competitive advantage for the Danish production industry. These things go hand in hand.

The first version of the baseline was published in April 2021 and was based on data from the period 2010-2018. In the 2022 version of the baseline, we have consolidated and future-proofed the dataset by working with data available through the Green National Accounts. This meant choosing a new 'starting year' for the baseline, i.e., 2012, since not all the data used for the original version was part of the Green National Account. This updated version also includes data from 2019.

The data in the baseline only relates to production that takes place in Denmark. We were not able to obtain data regarding outsourcing and resource extraction outside Denmark. Clearly, Denmark makes up only a small part of the global accounts but understanding and quantifying the Danish context is still important:

- Industry still accounts for a significant part of the total national impact on climate and environment and must be prepared to play an active part in reducing it.
- We must focus on how to create the best framework conditions for Danish companies to pursue sustainable production. As such, the solution must never be to move activities from Denmark to other countries with fewer demands and less regulation.
- In the fields where we succeed in creating novel and more efficient processes, technologies, etc., we will have laid the groundwork for scaling and export, i.e., improved competitiveness. Denmark has excellent preconditions for becoming a lab for sustainable solutions for future production solutions and products.

We hope you will agree, and we are looking forward to discussing both the baseline and the transition towards a more sustainable manufacturing industry in Denmark.

Enjoy your reading! *- The Danish Academy of Technical Sciences*

EXECUTIVE SUMMARY

We want Denmark to be a pioneer in sustainable production. The transition towards more sustainable production is an opportunity for strengthening the competitive position of Danish industry and has the potential to enable future growth and employment. But how can these ambitions be put into action? The transition towards a more sustainable production is complex and it calls for making the concept operational and concrete so that more companies will seize the opportunities.

Therefore, ATV and The Danish Industry Foundation have developed this baseline that documents how far Danish industry has come towards more sustainable production and traces its progression. In the baseline we focus on five effect indicators: resources; water consumption; energy consumption; CO2 emissions; and waste generation.

Overall, the baseline shows that industry as a whole has improved its productivity in all five indicators, but it also shows that productivity is higher for certain indicators, e.g., CO2 emissions, than for others, e.g., water consumption, and that there are considerable variations over the period measured.

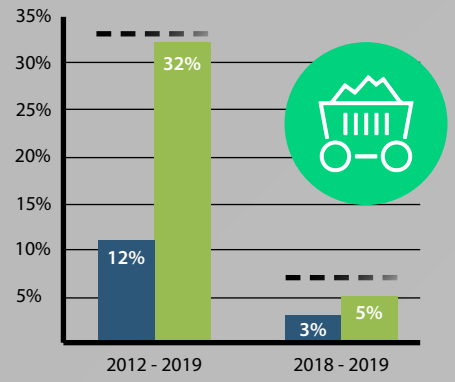
Industry has achieved a relative decoupling, meaning that it has produced more without increasing its consumption. This development is positive, for competitiveness and for sustainability. However, the rise in productivity has not been sufficient to realize an absolute decoupling: namely, resource consumption and waste generation increased during the period in question.

The baseline demonstrates a need for an increased effort on several fronts:

- A need for more data and common standards: The green transition should be data-driven. This will require companies to generate, analyze, and exchange more data within and across their value chains. The many stakeholders in the value chain need to contribute towards collecting and sharing data.

- New ways of cooperation within the value chain: The value chain is key to the sustainability transition. The value chain must be used actively and must be seen as central for both influence, development, and cooperation at all stages.

- From a reduction agenda to an innovation agenda: We will not succeed with transition towards a more sustainable production by simply reducing and optimizing. We must be creative and innovative if we are to succeed in decoupling industry's economic growth from its resource use and its emissions.



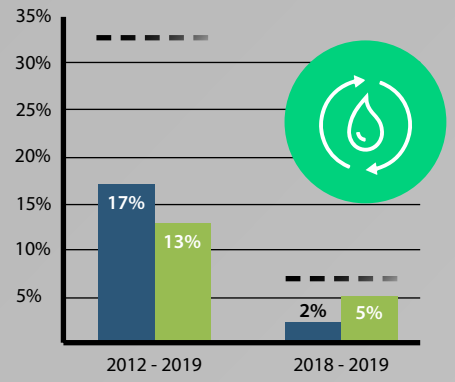
Resource Consumption

Industry's use of resources and its resource productivity were higher in 2019 than in 2012. Both parameters also increased from 2018 to 2019.

Gross value added

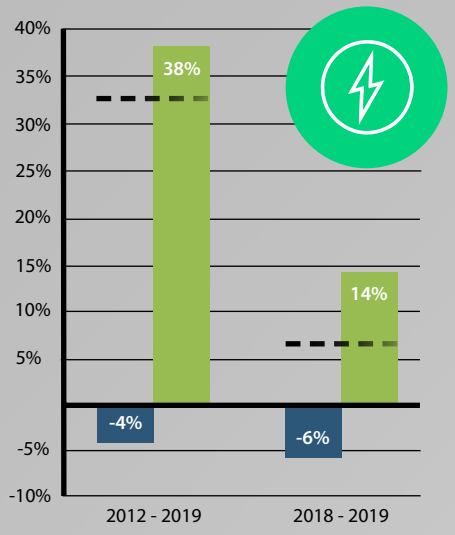
Productivity

Consumption/emission/generation



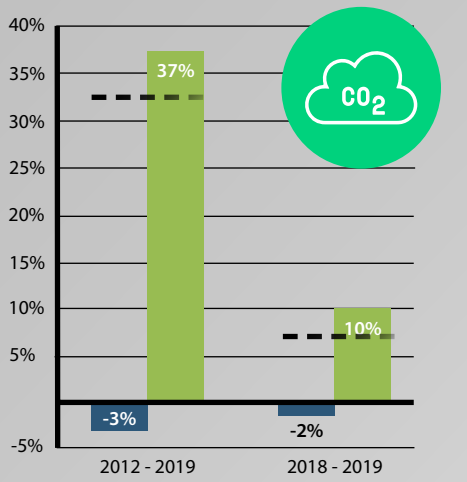
Water Consumption

Water consumption and water productivity increased from 2012 to 2019, this pattern is also seen from 2018 to 2019.



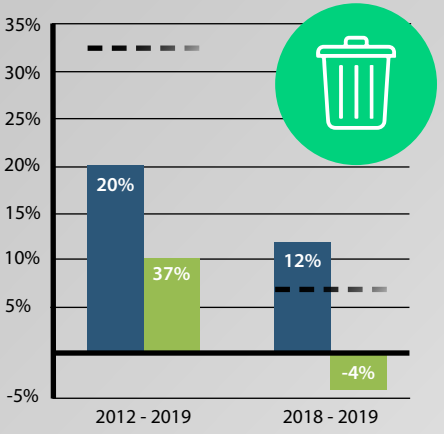
Energy Consumption

Energy consumption in industry decreased between 2012 and 2019 and from 2018 to 2019. Energy productivity increased in both periods and the increments were higher than the gross value added.



CO_2 Emissions

Emissions of CO2 decreased from 2012 to 2019 and between 2018 and 2019. The net increase in CO2 productivity exceeded the gross value added in both periods.



Waste Generation

Waste generation increased, both from 2012 to 2019 and between 2018 and 2019. From 2012 to 2019 waste productivity increased whereas it decreased from 2018 to 2019.

INTRODUCTION TO THE BASELINE

In this section we provide a short introduction to the five effect indicators and highlight some of the limitations which are relevant for the understanding of the baseline and our recommended focus areas.

WHY THE FIVE EFFECT INDICATORS?

"Sustainable development" as a concept was established in the Brundtland-report from 1987. The report defined the concept as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". Since then, many initiatives have worked towards operationalizing that ambition and translated it into a language which is inclusive and contains the many diverse sustainability challenges found across countries. In recent years, there have been two drives especially which have gained momentum: the climate crisis and the UN Sustainability Goals (The 17 SDGs).

The climate crisis and the need to limit CO2 emissions is about preventing temperature-increases and preventing the global climate from reaching irreversible tipping-points, which can accelerate negative development.

The SDGs have provided a shared language for addressing all aspects of sustainable development; they have provided individual countries and the worldwide community some concrete goals to aim for.

Both the climate crisis and the SDGs are relevant and important elements for the sustainable development of the Danish production industry. However, the two are not optimal starting points for a baseline. The sustainability agenda cannot be reduced to purely a need for reduction of CO2-emissions. If we do that, we are missing other important agendas such as resource shortage and waste generation. The SDGs are broad and take a holistic approach to sustainability. Nevertheless, the goals are also an expression of a global consensus and therefore not all suitable for the challenges that are most important to solve in relation to the Danish production industry. With that in mind and through dialogues with industry organizations, experts and individual companies, ATV has identified five areas which are central to sustainable development in Danish industry.

EFFECT INDICATORS

Resource Consumption
The Earth's resources are limited and will run out. Continued resource extraction has negative consequences for biodiversity, and is socially biased – there are both economic and technological consequences of the silicon shortage, for instance, which limits the production of microchips.

Energy Consumption
Energy usage is closely linked to CO2 emissions, which is why it is a key parameter for the baseline. We must, however, not only reduce energy consumption, but also make the transition to renewable energy sources and electrification. As a starting point, we measure energy usage in this baseline.

Water Consumption
Water resources are distributed unevenly around the globe. When water circulation is compromised, communities as well as businesses experience an increasing number of problems in terms of access to clean water. We need to focus on reducing water consumption in the Danish manufacturing industry, and this calls for developments in technology and processes that can also be used in other countries.

CO_2 Emissions
This is already established as a central parameter for the sustainable development of society. Therefore, it is one of the fields that should be measured when investigating Danish manufacturing industries.

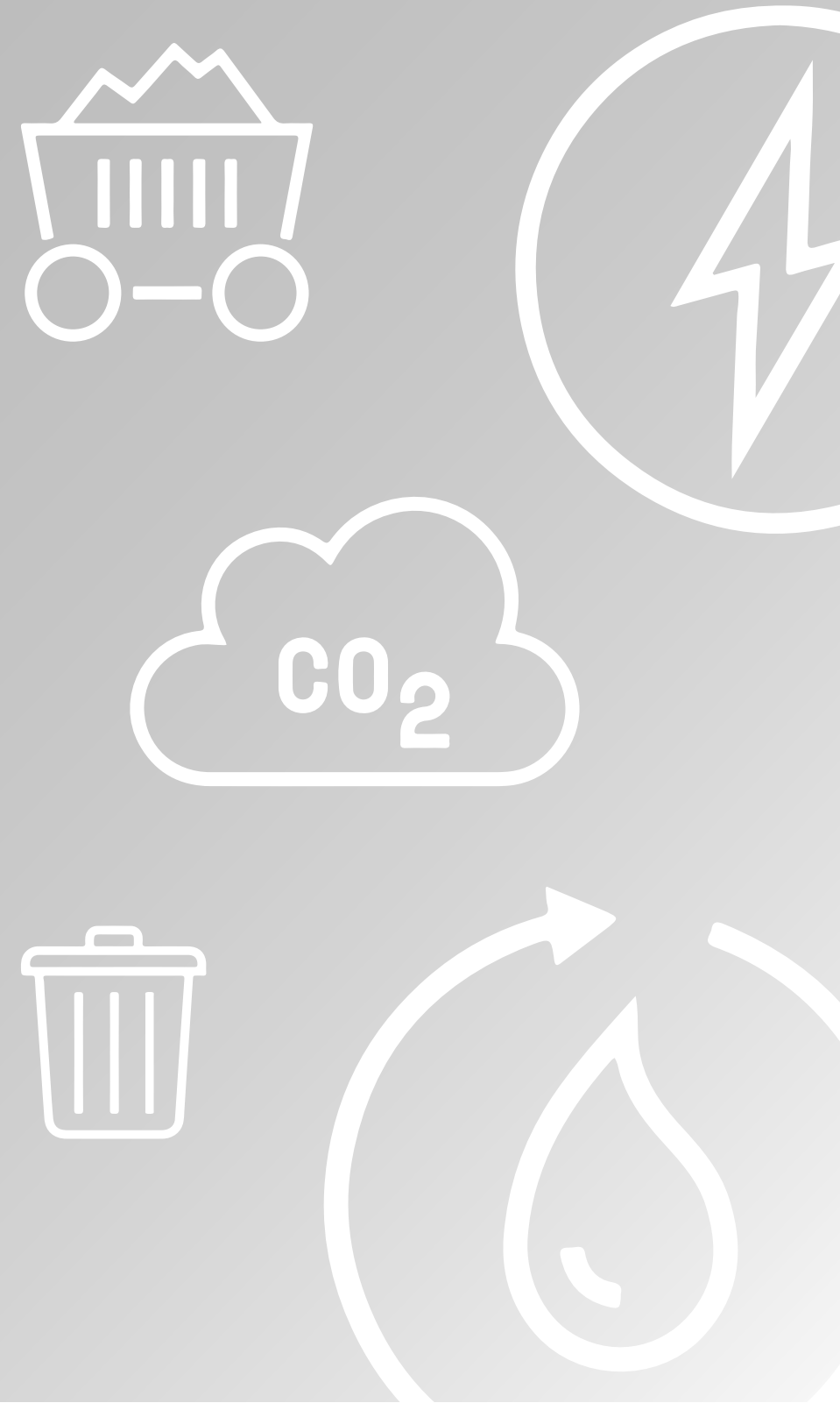
Waste Generation
The amount of waste must be reduced. In Denmark we have focused too much on waste-to-energy incineration. This has led to increased CO2 emissions as well as to an insufficient regard for waste as a resource to be recirculated and recycled.

DATA

The baseline is focused on the Danish production industry and the individual companies (C-industries) in Statistics Denmark's industry data sets. The data used to calculate the five effect indicators was collected by Statistics Denmark as part of the National Green Accounts. The five effect indicators are measured in different ways:

- Resource consumption is measured in Danish kroner (DKK) used on purchase
- Water consumption is measured in 1000 m3
- Energy consumption is measured in gigajoule (GJ)
- CO2-emissions are measured in 1,000 tons
- Waste generation is measured in tons.

Low amounts of units indicate low consumption/emissions/generation, and high amounts of units indicates high consumption/emission/generation. For each of the five effect indicators, the baseline outlines to what extent the collective industry is developing sustainably and in which direction it is moving. Furthermore, the baseline also describes the development in the individual industry and outlines where there is unresolved potential.



1. C-industries: CA Food-, drinks- and tobacco industry, CB Textile- and leather industry, CC Wood-, paper- and printing industry, CE Chemical industry, CF Pharmaceutical industry, CG Plastic-, glass- and concrete industry, CH Metal industry, CI Electronic industry, CJ Production of electronic equipment, CK Machine industry, CL Transport industry, CM Furniture- and other industry etc. Not including CD Oil refineries, etc. Data was collected by Damvad Analytics for ATV in October 2021.

2. Https://www.dst.dk/da/Statistik/emner/miljoe-og-energi/groent-nationalregnskab

BASELINE DESIGN

In the updated version of the baseline, we have standardized the presentation of all five effect indicators. For all five effect indicators the following three concepts are crucial for the evaluation of the individual industries' status and potential: Gross value added, Productivity and Relative/absolute decoupling.

Gross value added (GVA)

The gross value added expresses the value added in millions DKK for the production industry in the period 2012 to 2019. It is based on fixed prices from 2010 and in the figures illustrated with a white dotted line.

Productivity

The productivity for the different effect indicators is calculated by GVA divided by the total consumption/emissions/generation. It expresses how much value is created compared with the industry consumption/emission/generation and is measured in DKK.

Relative/absolute decoupling

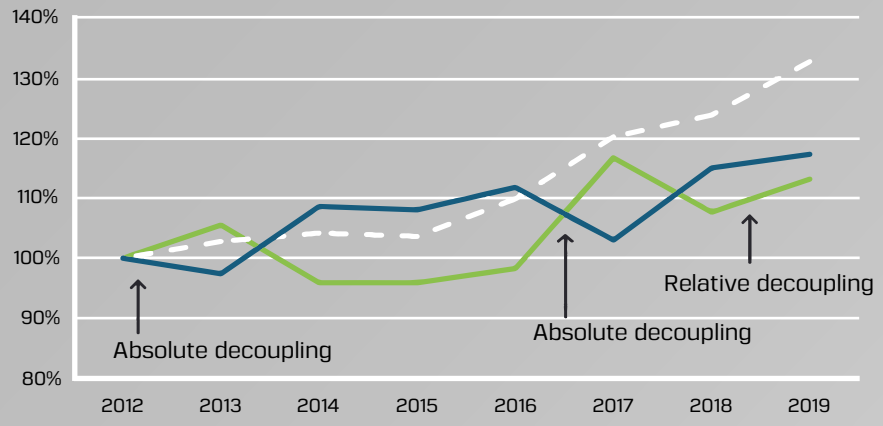
If we are to succeed with the green transition, we must decouple economic growth from growth in resource consumption, CO2-emissions, etc. In the baseline, we therefore compare GVA to growth/degrowth for each of the five effect indicators. By doing this, the baseline shows when a relative or absolute decoupling takes place (measured in consumption/emission/generation per unit GVA).

In relative decoupling the environmental effect per unit GVA decreases, but the environmental effect continues to rise. GVA therfore rises more than the environmental effects for the same period. In absolute decoupling the environmental effect decreases, even with a growing GVA.

READING GUIDE

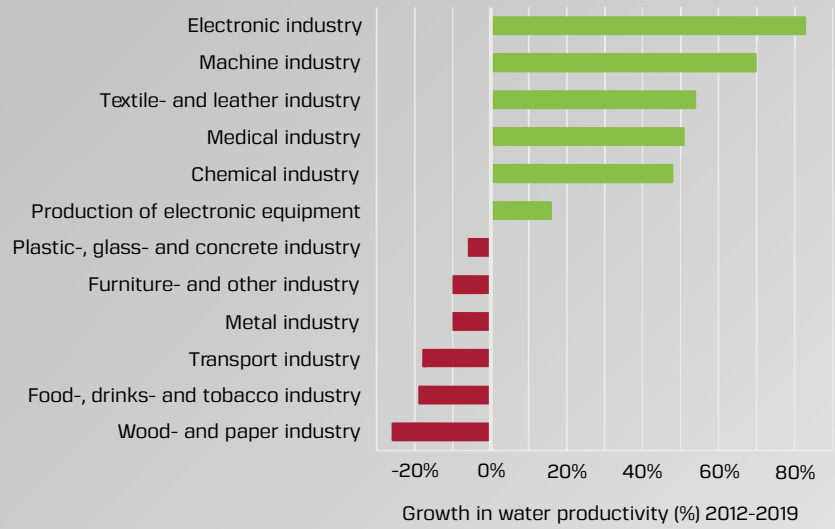
For each of the five effect indicators, we present five figures, four graphs and one illustrated assessment. In this section, we use water consumption as an example to explain the different figures.

The figure below shows the development in GVA (dotted), productivity (green) and consumption (blue). The development is based on index numbers, where 2012 = 100.



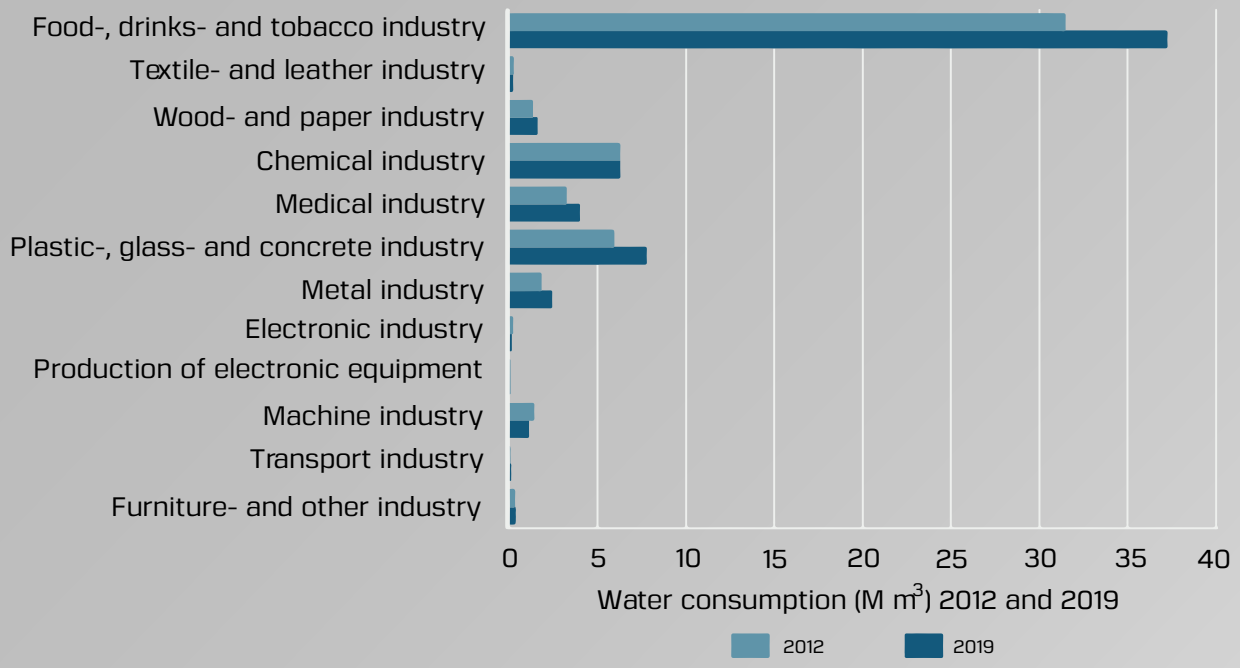
The arrows show where either an absolute decoupling or a relative decoupling takes place. The absolute decoupling occurs when there is a decrease in water consumption and an increase in GVA, the relative decoupling occurs when the increase in water consumption is lower than the increase in GVA.

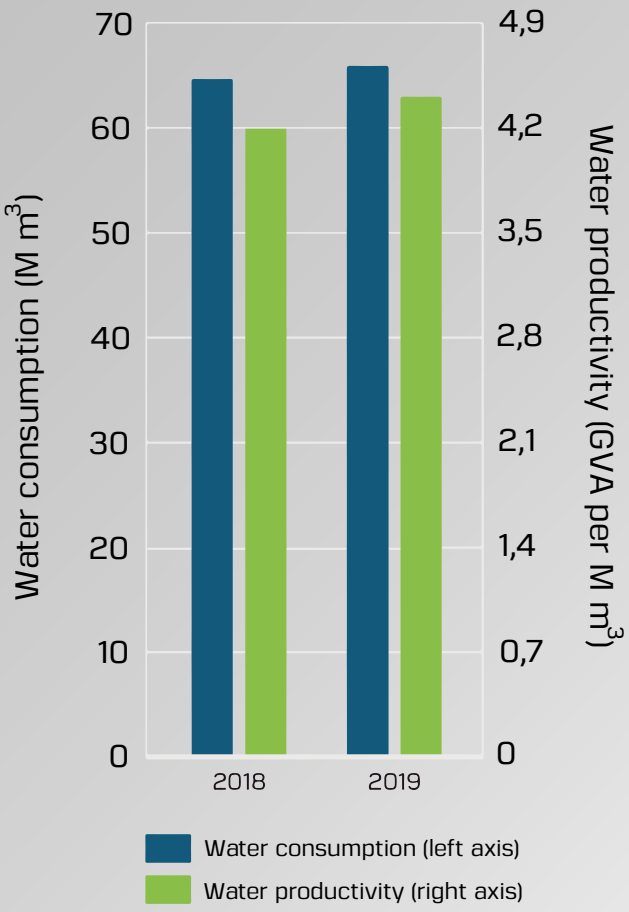
The figure below shows the development in productivity between 2012 and 2019 in relation to water consumption, meaning the value produced per unit water consumption (1,000 m3). A red line illustrates negative development; a green line illustrates positive development.



From the figure it is seen that the wood and paper industry has had a negative productivity of more than 20 %, which indicates that more than 20 % more water was used to produce the same value in 2019 as in 2012. On the other hand, the electronic industry has experienced an increase in productivity of more than 80 % during the same period, which indicates that they use 80 % less water to produce the same value.

These two figures express the actual water consumption of the specific industries and the industry all together. In addition, the figure on the right shows the productivity. Please note the varying values of the two vertical axes in the figure on the right.



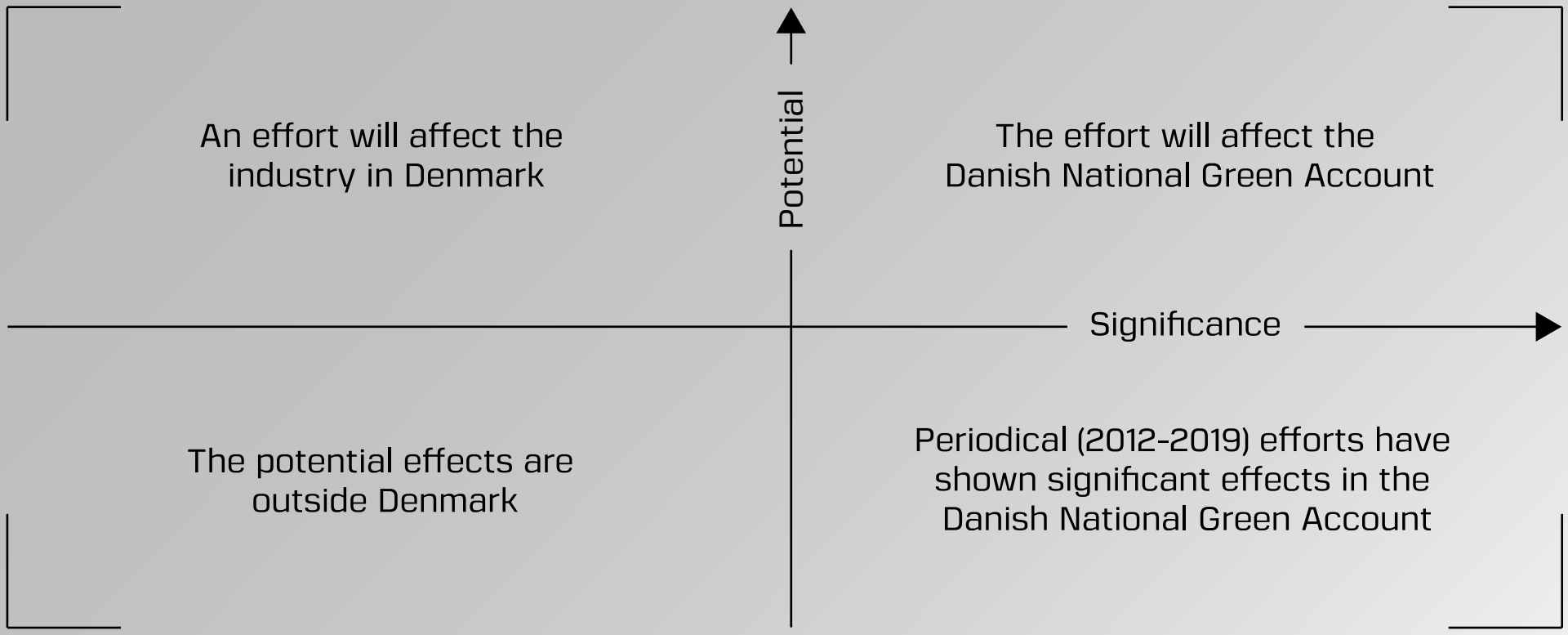


Focus areas for the industries

Inspired by the baseline data, we provide suggestions for future focus areas within the industries. This is not an easy task, primarily because data from Statistics Denmark is aggregated and multiple industries are grouped together. For example, the plastic-, glass- and cement industries are compiled in one category, and when we look at the CO2-emissions, the cement industry alone puts this category at the top of the scale, thus painting a skewed picture of the other industries in the category.

We have chosen to suggest potential focus areas, because the baseline is meant to inspire action and provide companies with a starting point for their analysis of their own focus areas and possibilities.

When we suggest potential focus areas, our starting point is the baseline-data and from there we estimate the potential (low productivity means large potential; high productivity means low potential) and the impact of the individual industries on the industry as a whole (how much the individual industry contributes to the combined consumption/emissions/generation of the whole industry). It is not possible to estimate the exact numbers or values for the potential, so we have defined the four categories below in which we place the different C-industries. By this division of the industries, we hope to provide the basis for a discussion of potential, focus areas and a new, more nuanced data collection.



RESOURCE CONSUMPTION

In this paragraph we introduce the baseline data for industrial resource consumption in Denmark

- Industry's absolute resource consumption amounts to **DKK 404,107 million** in 2012.
- Industry's absolute resource consumption amounts to **DKK451,307 million** in 2019 – the highest in the seven-year period 2012-2019.
- The lowest resource consumption was registered in 2013 and amounts to **DKK 389,160 million**

RESOURCE CONSUMPTION IN DANISH INDUSTRY

In absolute numbers, industry's resource consumption grew by 12% from 2012 to 2019. In that period there was both absolute and relative decoupling between resource consumption and the national gross increment. From 2012 to 2013 we see an absolute decoupling since resource consumption declines and gross increment rose. From 2013 to 2019 there was constant growth in resource consumption, and in 2019 we see a relative decoupling since the rise in resource consumption was lower than the rise in national gross increment. The period 2012-2019 shows a growth of 32 % in resource consumption. Figure 1.2 demonstrates that industry's total resource consumption rose from 2018 to 2019, and that resource productivity rose by 5% in the same period.

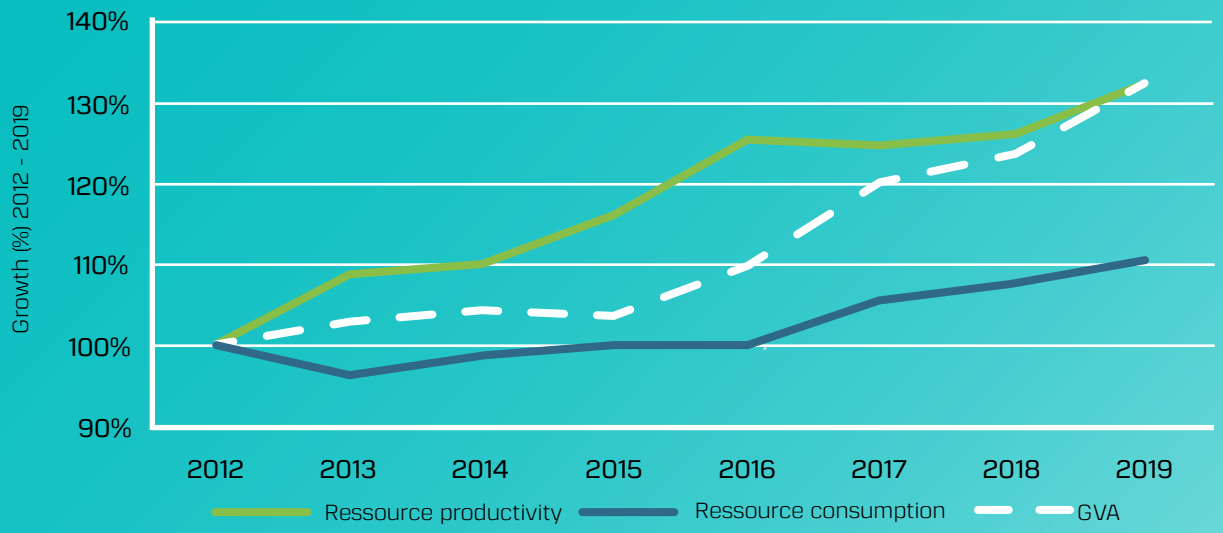


Figure 1.1 – Development in ressource consumption, GVA, and ressource productivity from 2012 to 2019 for the Danish industry.

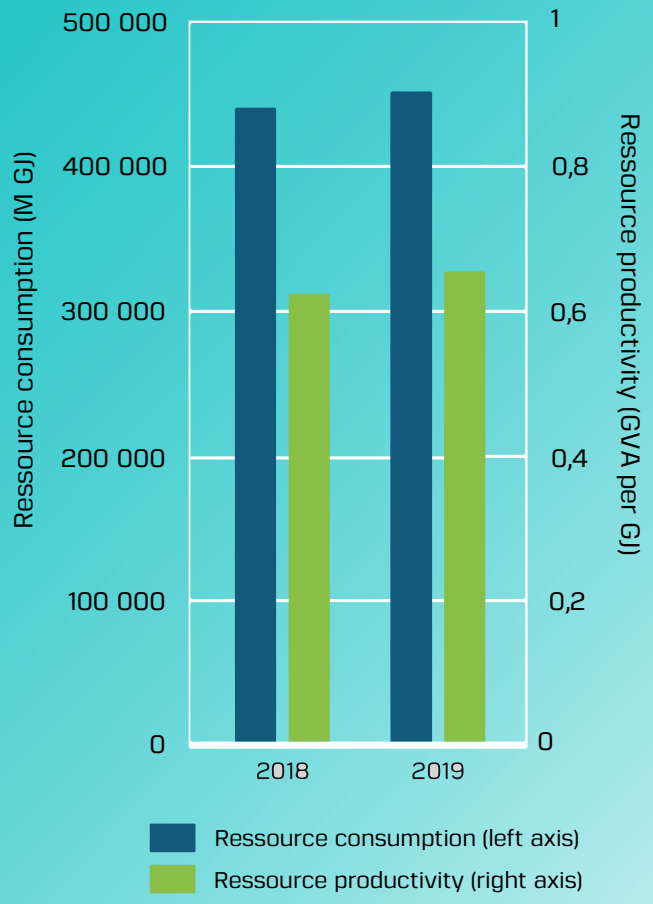


Figure 1.2 – Ressource consumption and productivity (2018-2019)

DEVELOPMENT IN RESOURCE CONSUMPTION DISTRIBUTED BY LINES OF INDUSTRIES

The resource consumption in the various fields of industry shows great variation. The resource consumption in food, drinks and tobacco industries and the machine industry have the largest overall consumption. The largest increases in resource consumption have taken place in the medical, the chemical and the furniture and other industries. In the wood- and paper industry and the electronics industry, resource consumption has decreased. These two fields, however, contributed only 2 and 3 percent of the total resource consumption (between 2018 and 2019).

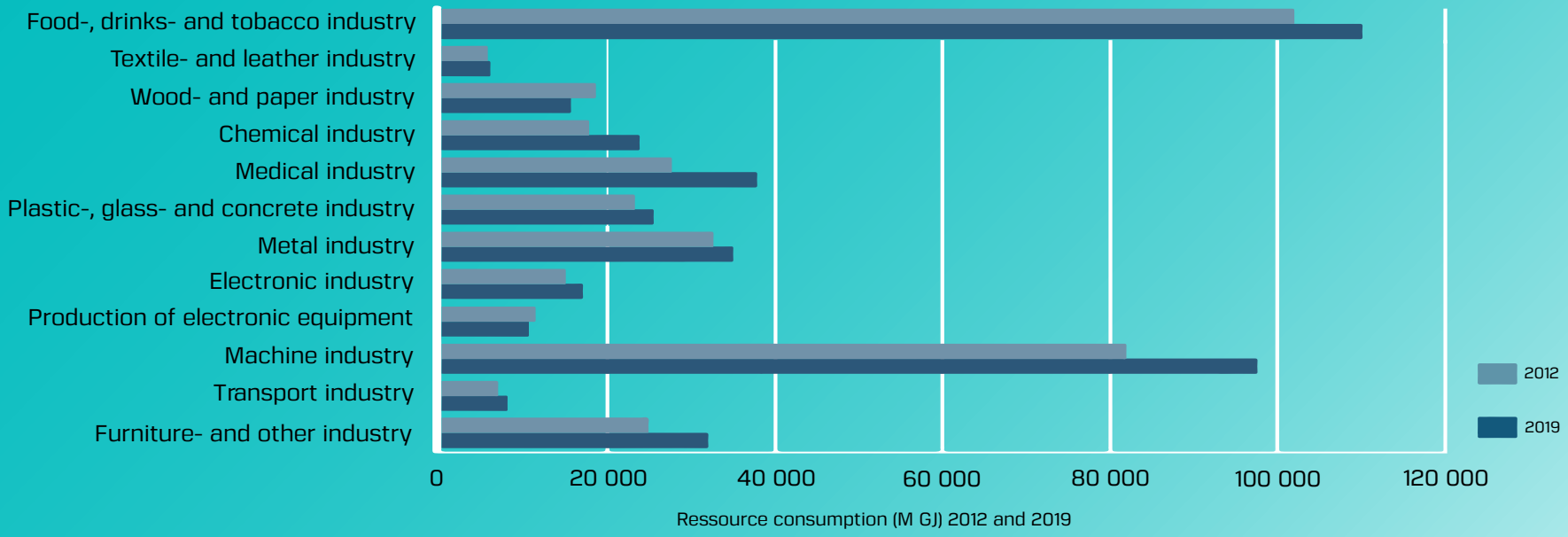


Figure 1.3 – Development in ressource consumption distributed by lines of industry.

DEVELOPMENT IN RESOURCE PRODUCTIVITY DISTRIBUTED BY BRANCH

In all but two industrial branches, resource productivity increased from 2012 to 2019. The Pharmaceutical industry's 37% increase stands out from the other branches. The marked decrease in resource productivity in the Furniture and other industries from 2012 to 2019 is also notable. There is no explanation given as such, but an obvious explanation might be that this industry is more subject to rising prices of raw materials, compared to other branches.

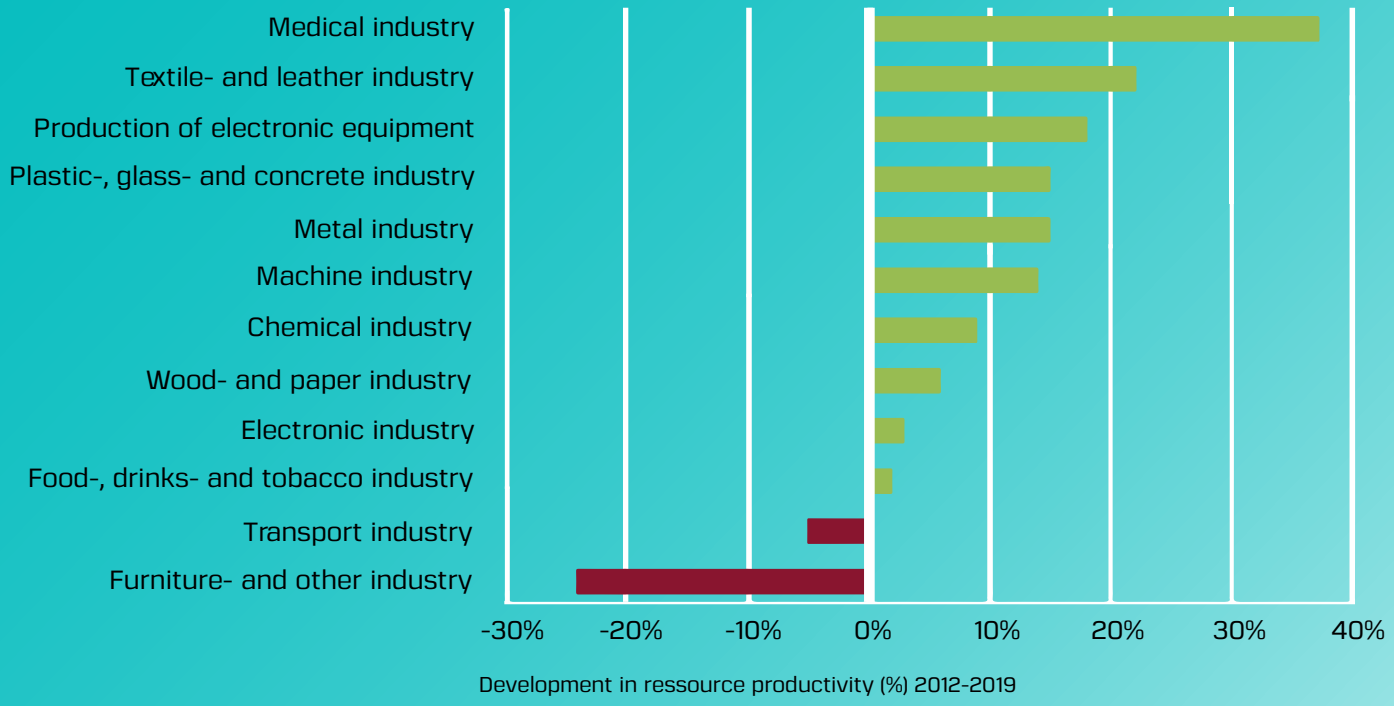


Figure 1.4 – Development in resource productivity on industrial branch level, 2012-2019

RESOURCE CONSUMPTION FOCUS AREAS

The medical industry has managed to increase its resource productivity by 37 % from 2012 to 2019. Therefore, we consider the potential for a large increase in productivity limited. In the branch food, beverage, and tobacco manufacturing there is potential for increasing resource productivity since it has only increased by 2% from 2012 to 2019. Since the food, beverage and tobacco industry takes up the largest part of the absolute consumption of resources, it will have great impact if this branch manages to increase resource productivity. The same is true for the machine industry.

Both in the automotive industry and furniture and other industries, resource productivity has decreased. Despite potential for better resource productivity in these branches, the total effect will be marginal, since they take up minor parts of total resource consumption in Denmark.

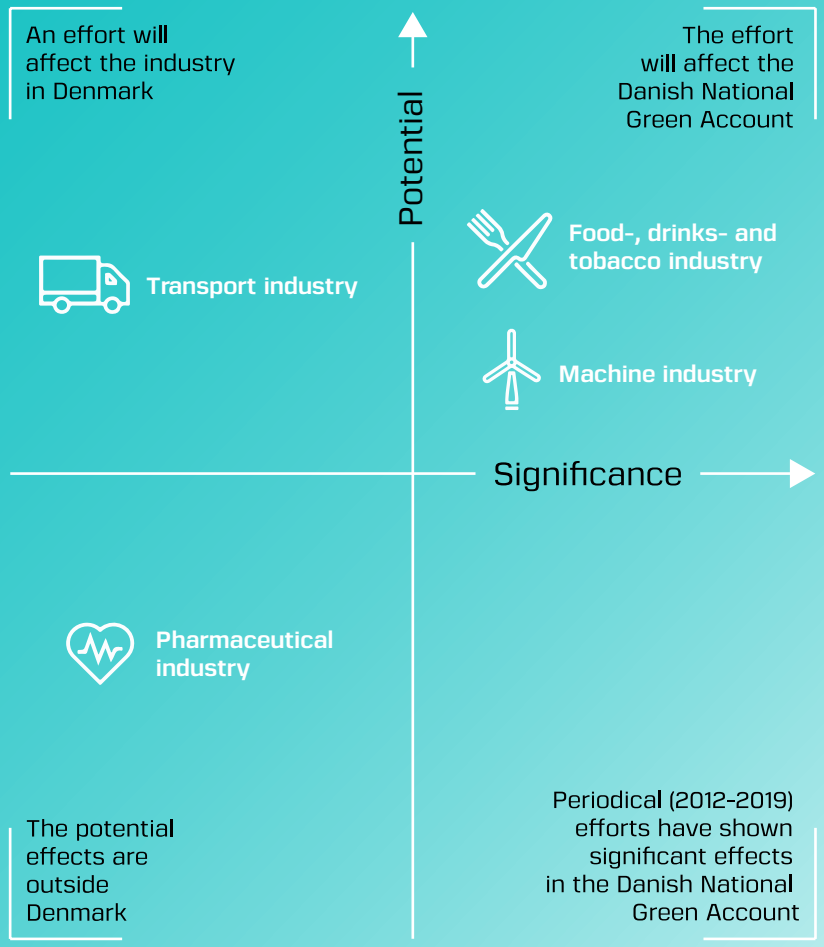


Figure 1.5 - Potential for and impact of branches' effort concerning ressource consumption.

WATER CONSUMPTION

In this paragraph we introduce the baseline data for industry's water consumption in Denmark

- In 2012, the absolute water consumption of Danish industry amounted to **56.2 million m^3.**
- In 2019, the absolute water consumption of Danish industry was **65.9 million m^3** – the highest in the period 2012-2019.
- In 2013, the lowest consumption was measured, amounting to **54.8 million m^3.**

WATER CONSUMPTION OF DANISH INDUSTRY

In the period 2012-2019, industry's absolute water consumption increased by 17%. Figure 2.1 shows that both absolute and relative decoupling between water consumption and gross value added took place in that period. In the periods 2012-2013 and 2016-2017 an absolute decoupling took place, since water consumption decreased and gross value-added increased. From 2018 to 2019 a relative decoupling took place, since the increase in water consumption was lower than the increase in gross value added. Between 2012 and 2019, water productivity increased by 13%. Figure 2.2 demonstrates that industrial absolute water consumption increased by 2% from 2018 to 2019, and that water productivity increases by 5% in the same period.

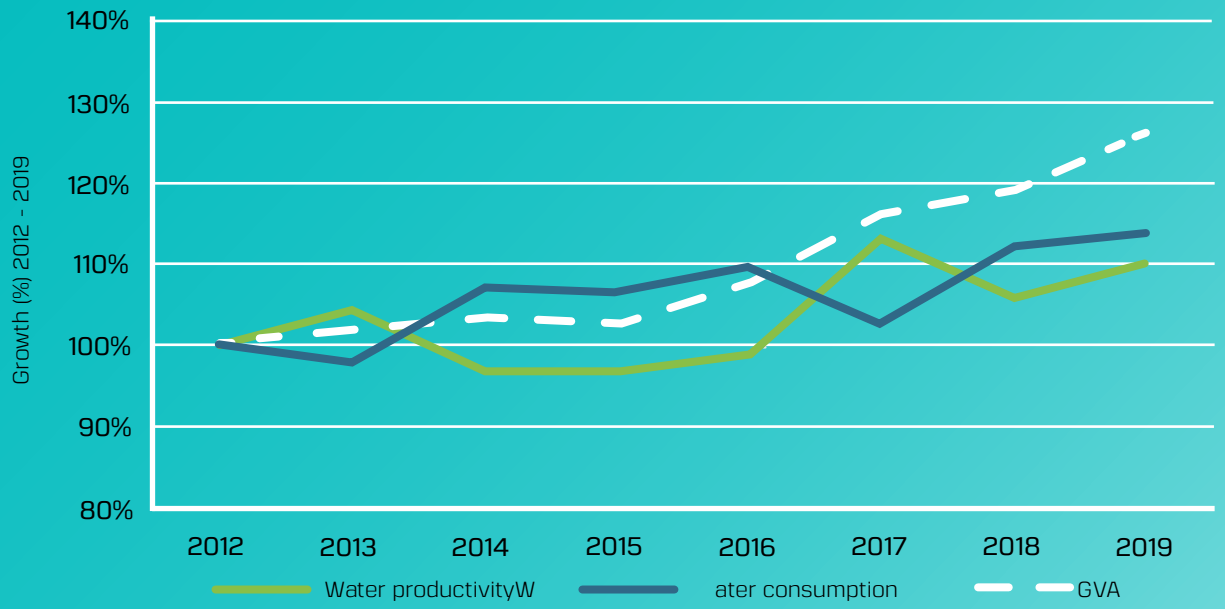


Figure 2.1 – Development of water consumption, GVA and water productivity, 2012-2019 for industry as a whole.

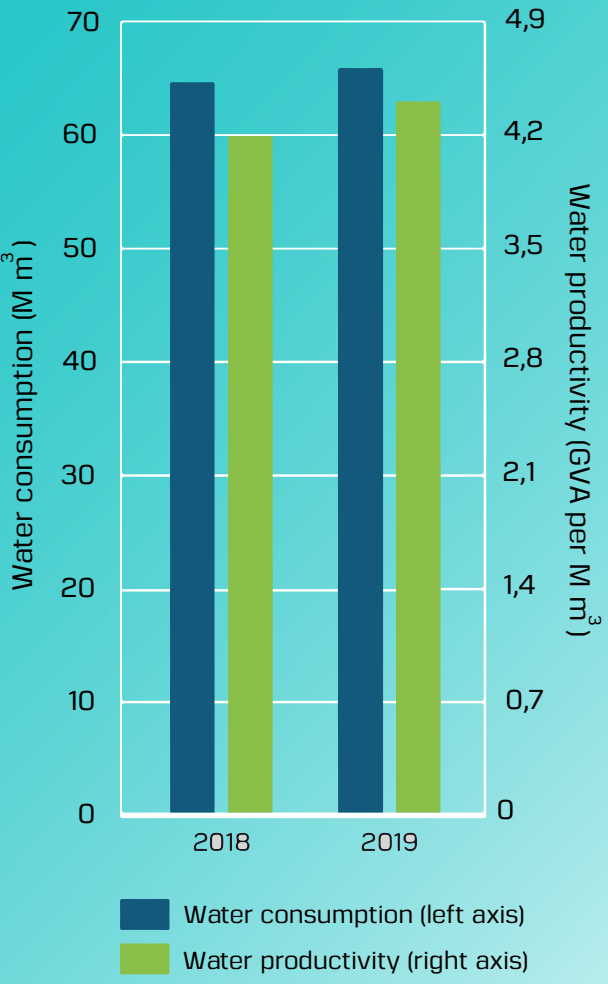


Figure 2.2 – Water consumption and water productivity for industry as a whole in 2018 and 2019.

DEVELOPMENT IN WATER CONSUMPTION DISTRIBUTED BY BRANCH

The branch comprised of food, beverage and tobacco industries is the branch with the absolute highest water consumption (37.2 M m3). Water consumption in this branch was 379 % higher than consumption in plastic, glass, and concrete industries, which took second place (7.8 M m3). Water consumption in the industries of machine; metal; wood- and paper; pharmaceutical; and chemicals, varied between 1 and 7 M m3. The largest increments from 2012 to 2019 took place in the automotive industry, the metal industry and the plastic-, glass- and concrete industries. Here water consumption increased by 37, 34 and 31 percent respectively. In the electronic, machine and textile- and leather industries, there was a decrease in water consumption from 2012 to 2019 by 33, 22 and 13 percent respectively.

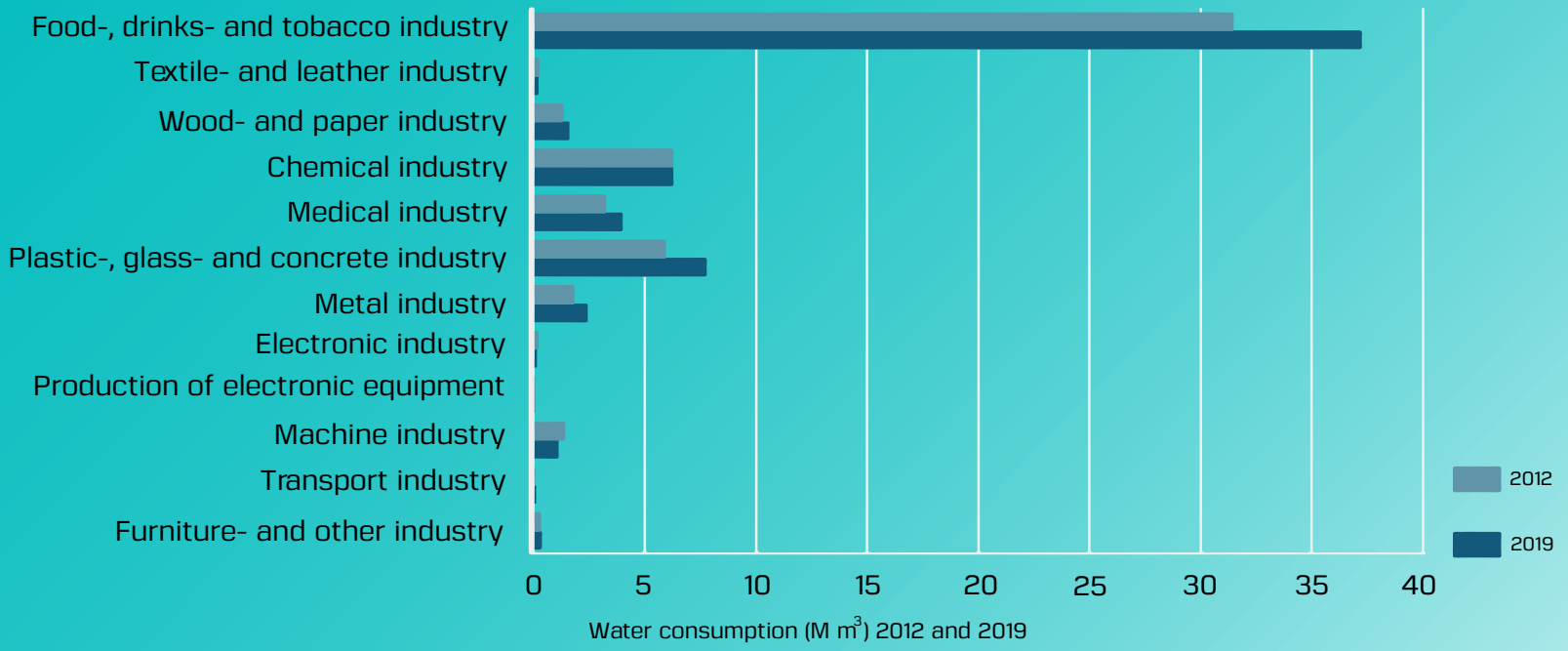


Figure 2.3 - Water consumption for industrial branches in 2012 and 2019.

DEVELOPMENT IN WATER PRODUCTIVITY BY BRANCH

Water productivity differed hugely between the branches with a variation of approximately 110%. In the textile- and leather industry, the machine industry and the electronic industry, water productivity increased by 54 %, 70 %, and 83 % respectively from 2012 to 2019. However, a decrease in water productivity is seen in half of the branches. The biggest decrease is seen in wood and paper industries, the food-, beverage-, and tobacco industries, and the automotive industry, where water productivity decreased by 26 %, 19 % and 18 % respectively.

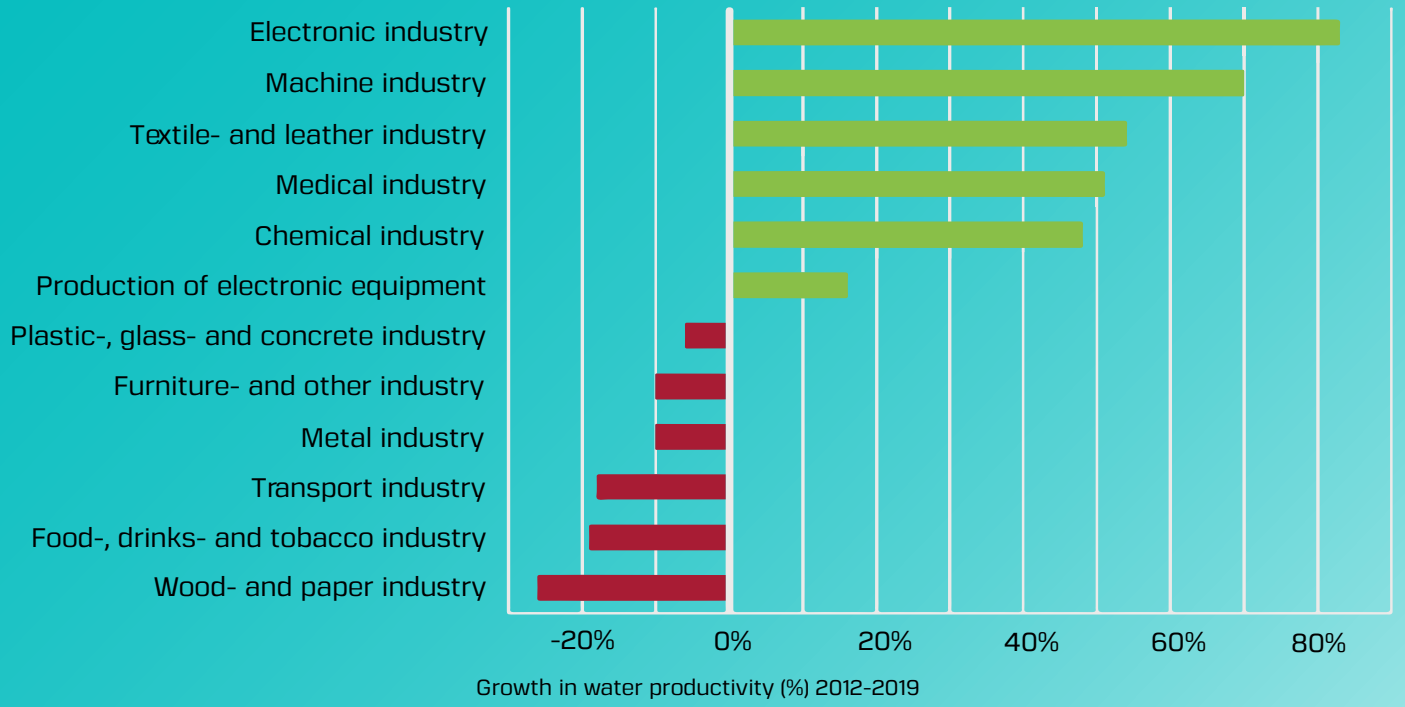


Figure 2.4 - Development in water productivity by industrial branch, 2012-2019

WATER CONSUMPTION FOCUS AREAS

The positive development in water productivity indicates that especially the textile- and leather industries, the machine industry and the electronics industry succeeded in making their water consuming processes more efficient from 2012 to 2019. Water consumption of industry as a whole constituted only 2 % of society's total water consumption, therefore there is a limit to the importance of and potential for further development. Water consumption in the food-, beverage- and tobacco industries made up 56 % of industry's total consumption and since water productivity in these industries decreased by 19 %, this branch has great potential for development. The chemical industry constituted 10 % of total industrial water consumption. From 2012 to 2019 there were no changes in water consumption, but water productivity increased by 48 %, meaning that the chemical industry had a positive impact. Since the gross value added in the plastic-, glass- and concrete industries, the metal industry and in furniture- and other industries does not correlate to the increments in water consumption, water productivity decreased. Water consumption within these branches amounted to 12 % of the combined industries' total water consumption. Thus, there is potential for development and if an effort is made, it will influence Danish water consumption. In the wood- and paper industries, water consumption increased by 20 %, whilst water productivity decreased by 26 % from 2012 to 2019. Water consumption within this branch amounted to 2 % of all industries' total water consumption. Therefore, the branch is regarded as having minor importance, whereas the potential for positive effects of any efforts are regarded as positive.

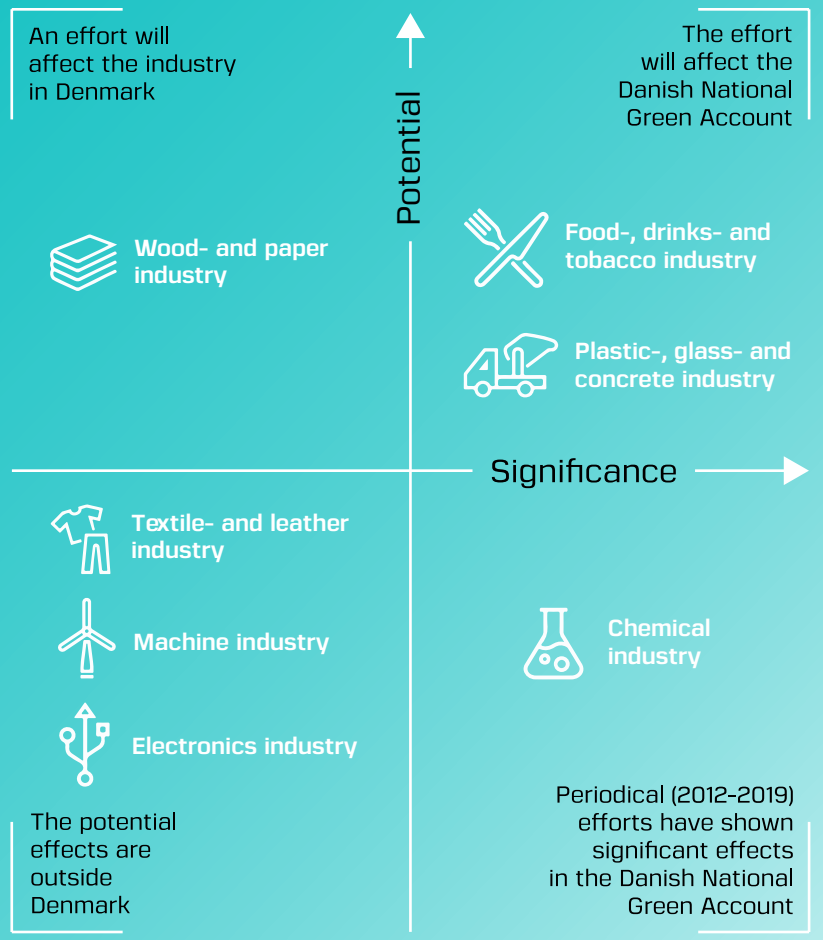


Figure 2.5 - Potential for and impact of branches' effort concerning water consumption.

ENERGY CONSUMPTION

In this paragraph we introduce the baseline for industry's energy consumption in Denmark

- Industry's absolute energy consumption in 2012 was **122,5 GJ**
- Industry's absolute energy consumption in 2019 was **117,3 GJ** - the lowest measured from 2012 to 2019
- Industry's highest energy consumption was measured in 2018 and amounted to **124,5 GJ**

ENERGY CONSUMPTION WITHIN DANISH INDUSTRY

From 2012 to 2019, the absolute energy consumption of all industries in Denmark decreased by 4 %, and during that period there were both increases and decreases in energy consumption. From 2015 to 2018, a relative decoupling took place since gross value added increased more than energy consumption. From 2018 to 2019, an absolute decoupling took place, since energy consumption decreased whilst gross value added still rose. Energy productivity increased by 38 % from 2012 to 2019. Figure 3.2 shows that absolute energy consumption decreased by 6% from 2018 to 2019. Throughout the seven-year period, energy prices were stable and the wish to contribute to the green transition created a heightened consciousness for reducing energy consumption in businesses. The numbers show that there is no direct link between increasing GVA and energy consumption.

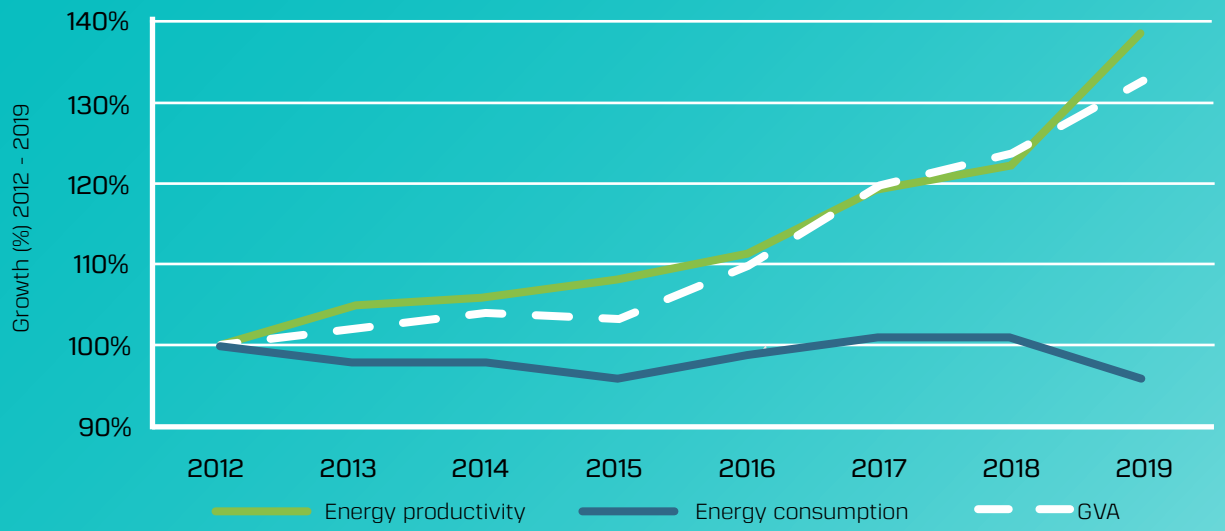


Figure 3.1 – Development in energy consumption, GVA and energy productivity from 2012-2019 for industry as a whole.

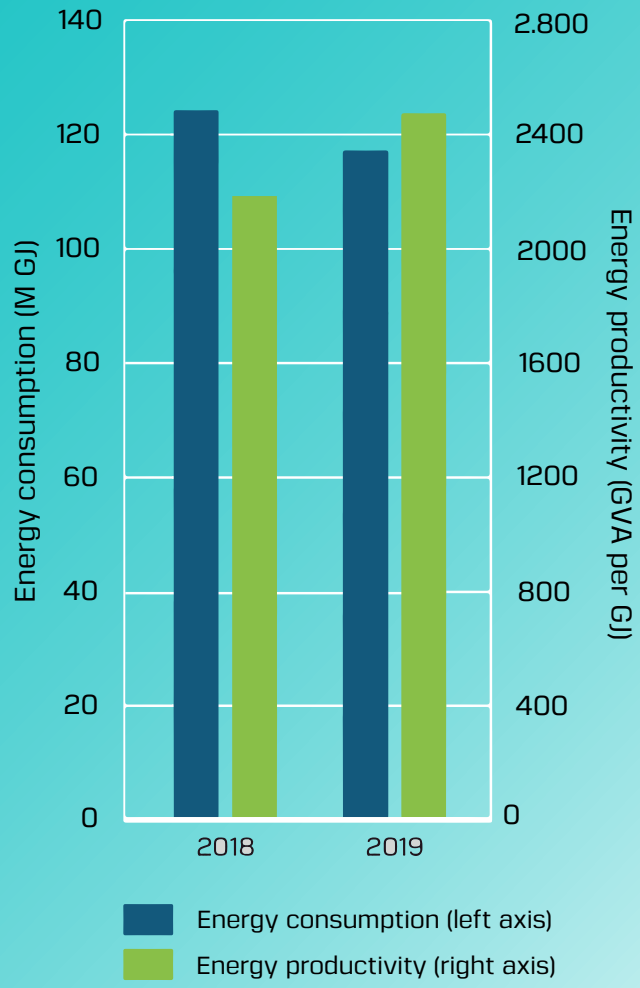


Figure 3.2 – Energy consumption and energy productivity for industry as a whole in 2018 and 2019.

DEVELOPMENT IN ENERGY CONSUMPTION DISTRIBUTED BY BRANCH

All branches except the plastic-, glass- and concrete industries show a decrease in energy consumption from 2012 to 2019. The food-, beverage- and tobacco industries had the highest energy consumption in 2012 as well as in 2019, whilst decreasing by 7 % in that period. In 2019 this branch's energy consumption was 23 % of the absolute energy consumption in industry as a whole. The plastic-, glass-, and concrete industries show the second highest consumption of energy, and throughout the 2012-2019 period, consumption increased by 8 %. In 2019, the industry was responsible for 22 % of total energy consumption in industry as a whole. The largest decrease in energy consumption was in the automotive industry and the textile- and leather industries, where energy consumption was reduced by 39 and 29 percent respectively. However, energy consumption within these two branches was only responsible for 2 % of industry's combined, absolute energy consumption.

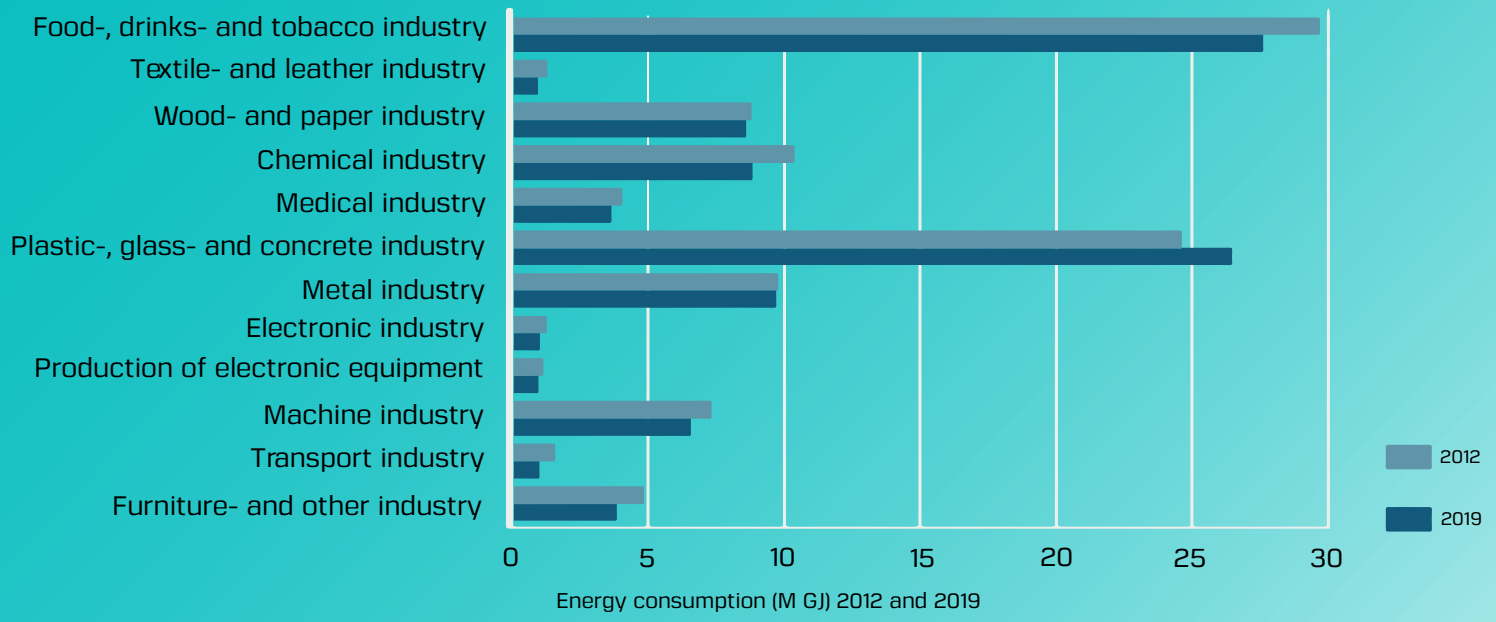


Figure 3.3 - Energy consumption for various industrial branches in 2012 and 2019.

DEVELOPMENT IN ENERGY PRODUCTIVITY BY BRANCH

Energy productivity between the branches varied close to 100%. All branches, with the exception of the wood and paper industries, showed an increase in productivity. In the pharmaceutical industry, energy productivity increased by 108 % from 2012 to 2019. The smallest increases were in the food-, beverage-, and tobacco industries and in the plastic-, glass- and concrete industries, where energy productivity increased by 3 % and 15 % respectively. In the wood- and paper industries productivity decreased by 9 % from 2012-2019.

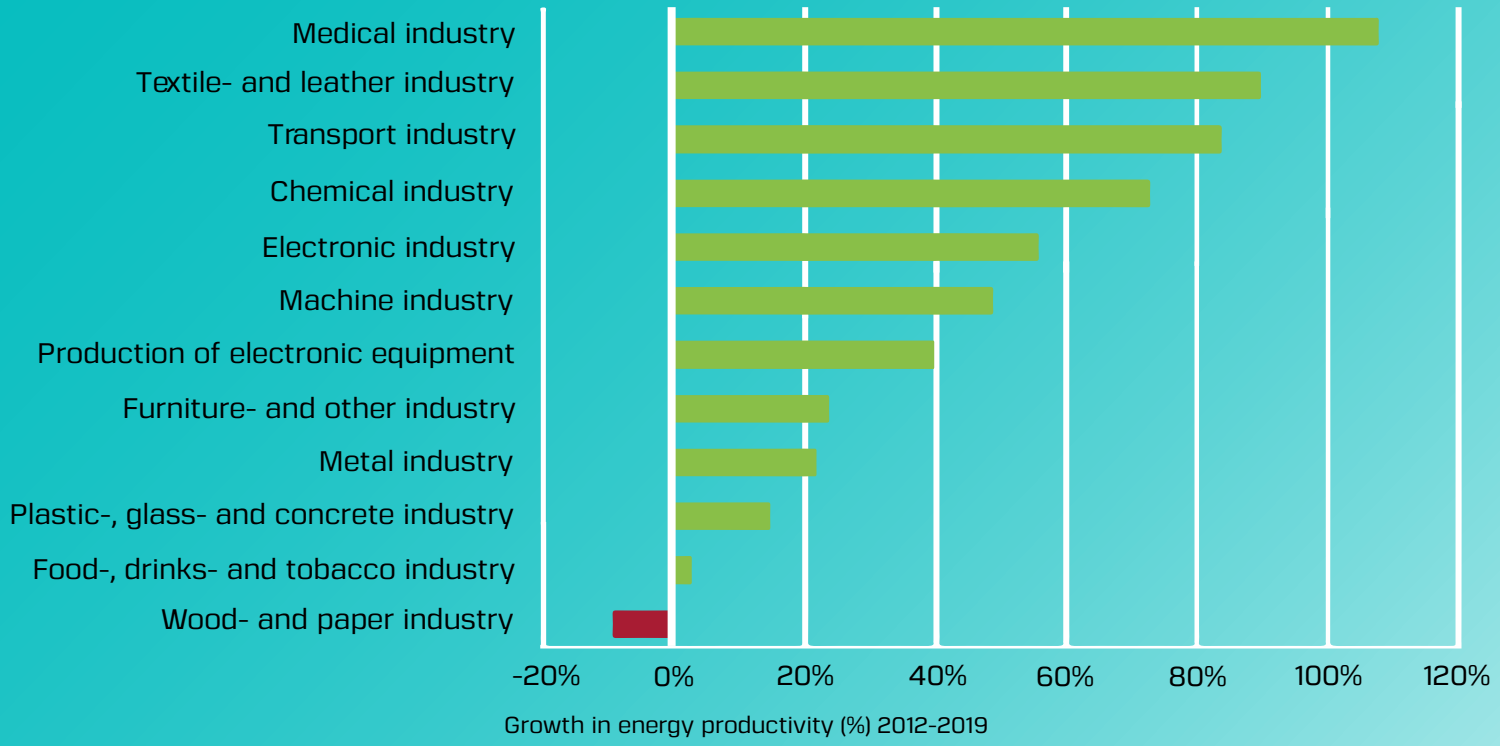


Figure 3.4 - Development in energy productivity by industrial branch, 2012-2019.

ENERGY CONSUMPTION FOCUS AREAS

From 2012 to 2019, energy consumption in the pharmaceutical industry decreased by 10 %. In the same period, energy productivity increased by 108 %. This branch, however, is only responsible for 3 % of the energy consumption of industry as a whole, and so the pharmaceutical branch has neither great impact nor great potential. The same is true for the automotive industry and the textile- and leather industries, which enhanced productivity by 84 % and 90% respectively, but which in 2019 both stood for only 1% of the combined industries' energy consumption.

Energy consumption in both the food-, beverage-, and tobacco industries and in the plastic-, glass-, and concrete industries each amounted to 20 % of the total energy consumption in 2019, for which reason these two branches are regarded as having major importance. Energy consumption in the food-, beverage- and tobacco industries decreased by 7 % from 2012 to 2019, whereas energy consumption in the plastic-, glass- and concrete industries increased by 8 %. In the seven-year period, energy productivity increased by 3 % and 15 % respectively. Hence both the potential for and impact on positive development is regarded as major. Energy consumption in the chemical industry decreased by 15 % from 2012 to 2019 and in the same period, energy productivity increased by 73 %. Energy consumption within the chemical industry amounted to 7 % of the combined industries' consumption in 2019. Against the background of the significant increase in energy productivity and the decrease in energy consumption, this branch is regarded as having major importance for Danish (energy) accounting.

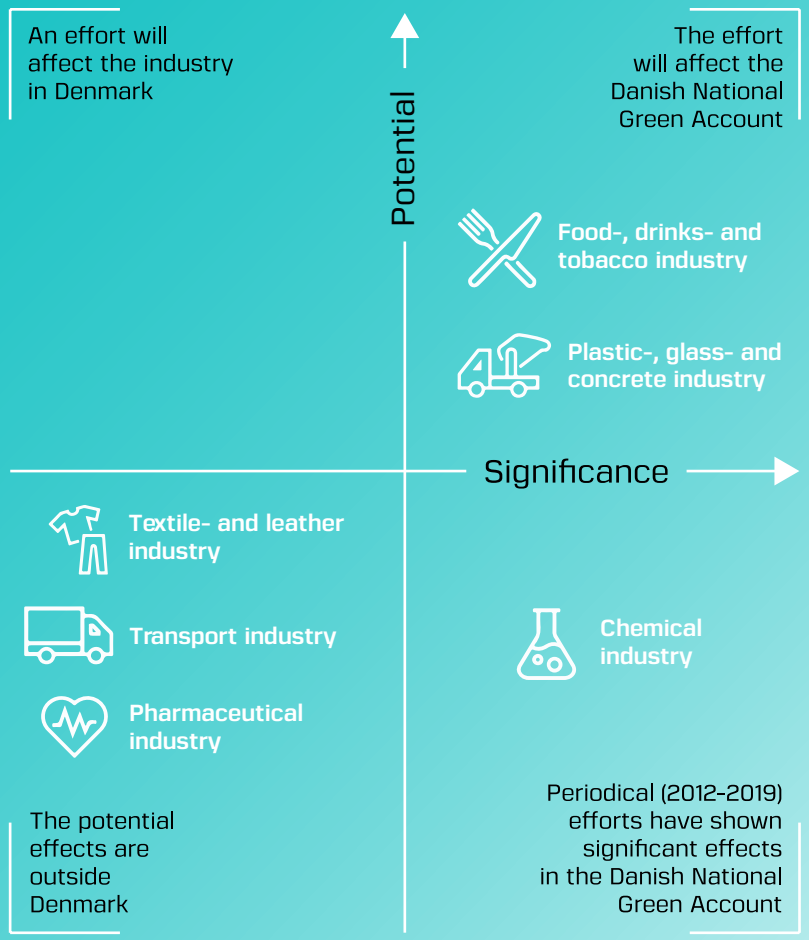


Figure 3.5 - Potential for and impact of branches' effort concerning water consumption.

CO2 EMISSIONS

In this paragraph we introduce the baseline for industry's CO2 emissions in Denmark

- Industry's absolute CO2 emissions in 2012 were **5,9 million tons**
- Industry's absolute CO2 emissions in 2019 were **5,7 million tons**
- The lowest CO2 emissions produced by industry were measured in 2013 and amounted to **5,6 million tons**
- The highest CO2 emissions produced by industry were measured in 2018 and amounted to **6 million tons**

CO2 EMISSIONS WITHIN DANISH INDUSTRY

Industry's absolute CO2 emissions declined by 3 % from 2012 to 2019. Figure 4.1 shows that an absolute decoupling took place from 2012 to 2013, from 2017 to 2018 and from 2018 to 2019, since GVA increased and absolute industrial CO2emissions decreased. From 2015 to 2016 and 2016 to 2017, a relative decoupling took place, since GVA increased more than CO2 emissions. In the whole seven-year period from 2012 to 2019, CO2 productivity increased by 37 %. This increase is 8 % higher than in the six years from 2012 to 2018. Figure 4.2 demonstrates that total CO2 emissions decline from 2018 to 2019, and that CO2 productivity increased by 10 % in the same period.

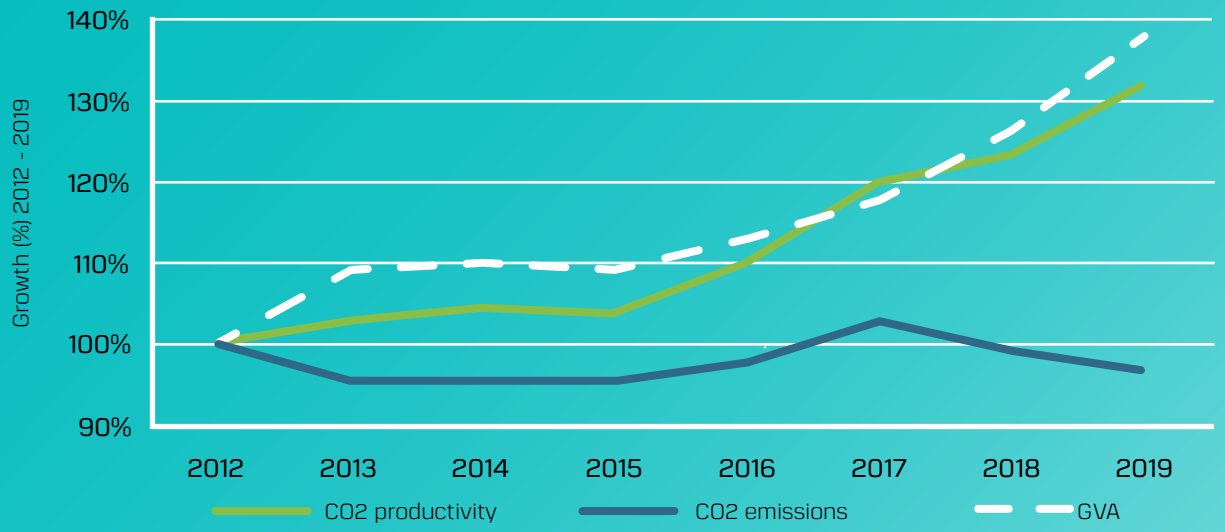


Figure 4.1 – Development in CO2 emissions, GVA and CO2 productivity from 2012-2019 for industry as a whole.

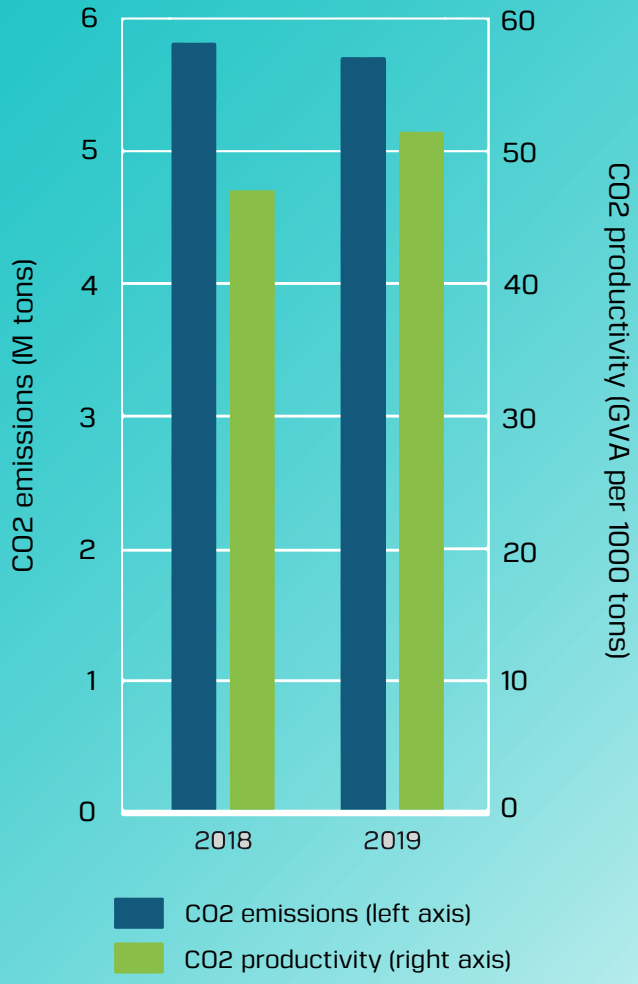


Figure 4.2 – CO2 emissions and CO2 productivity for industry as a whole in 2018 and 2019.

DEVELOPMENT IN CO2 EMISSIONS DISTRIBUTED BY BRANCH

In all branches, except for the plastic-, glass- and concrete industries, CO2 emissions fell from 2012 to 2019. The plastic-, glass- and concrete industries were responsible for 51 % of absolute carbon emissions in industry, and from 2012 to 2019, these emissions increased by 21 %. The food-, beverage-, and tobacco industries were responsible for 17 % of absolute, total industrial emissions in 2019. Between 2012 and 2019, however, these emissions decreased by 21 %. The biggest reductions in carbon emissions took place in the machine industry, under production of electrical equipment, and in the electronics industry, where emissions decreased by 40 %, 45 % and 54 % respectively. In 2019 emissions from these branches constituted 2 % of the combined industries' emissions. CO2 emissions from the plastic-, glass- and concrete industries were remarkably high. This is probably due to the fact that many of these businesses are process businesses which produce 24 hours a day, 365 days a year. To the extent that these processes are not electrified or converted to renewable energy sources, this will lead to high CO2 emissions. Another characteristic of this specific branch is that its production facilities have an expected life span of several decades. On top of that, the concrete industry by itself is Denmark's highest CO2-emitting industry, and since the plastic- and glass industries are in the same C branch, data from these branches will be influenced.

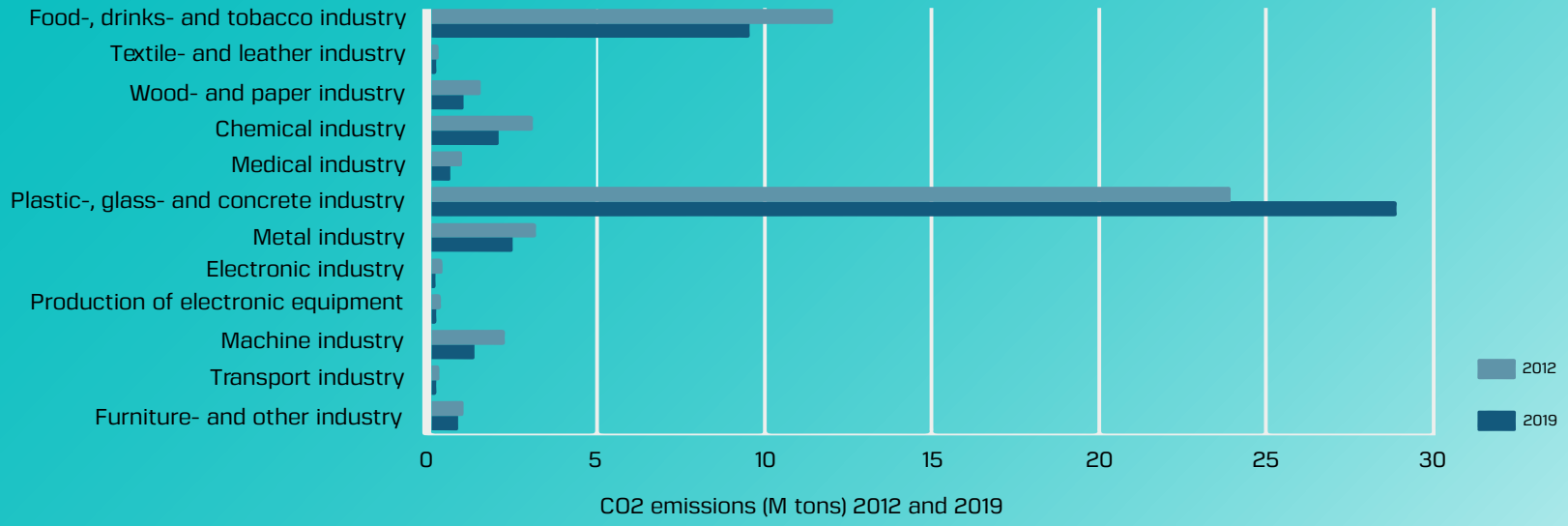


Figure 4.3 - CO2 emissions for various industrial branches in 2012 and 2019.

DEVELOPMENT IN CO2 PRODUCTIVITY BY BRANCH

There are significant variations in CO2 productivity between the branches – from 2 % to 200 % in the 2012-2019 period. The biggest increases are seen in the pharmaceutical industry and the electronics industry, where the increases are 200 % and 167 %. However, the increase in CO2 productivity in the plastic-, glass- and concrete industries was only 2 %. In the branches for the production of electrical equipment, the chemical industry and the machine industry, productivity rose by more than 100 %. A direct comparison between the development within different branches is not relevant. It must be seen in the light of the widely differing conditions for the branches, and that the classification of industrial branches may obscure significant variations amongst the sub-branches. Thus, some industries may have better opportunities for electrification whilst others have outsourced their production – in which case the CO2 load does not count in Danish national carbon dioxide calculations. Other industrial branches may not have experienced favorable market developments, which in turn could lead to higher productivity. Thus, it is crucial to investigate the conditions of each branch. That said, it is still true that this statement can indicate potential and opportunities for taking measures.

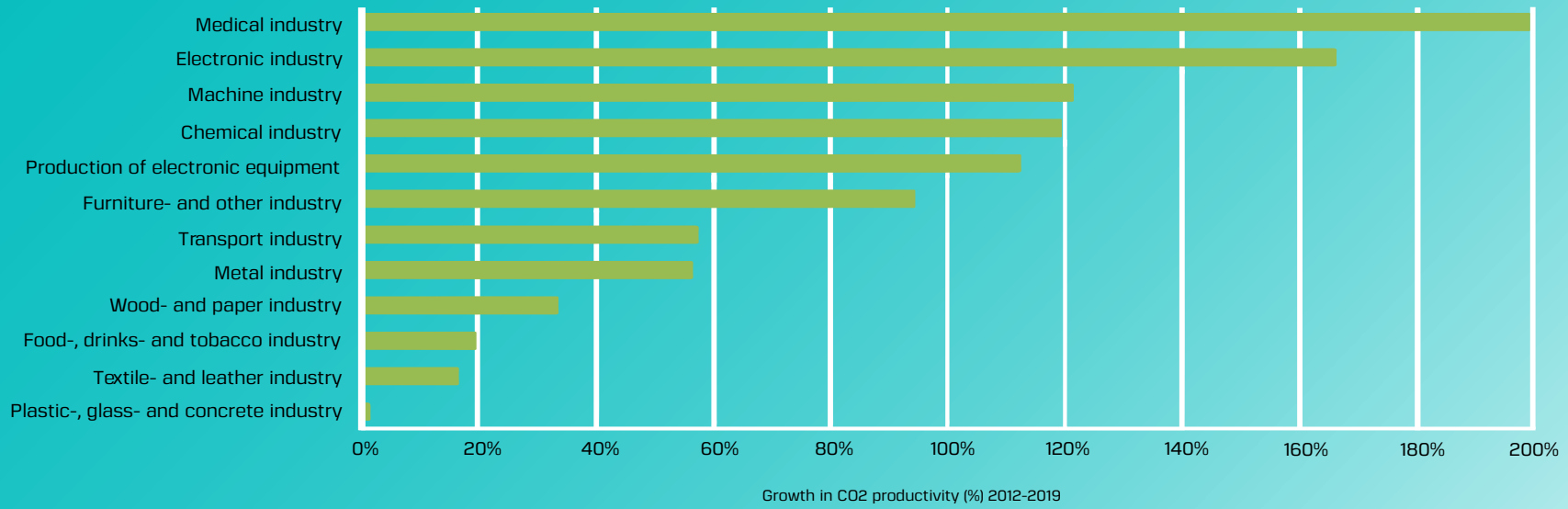


Figure 4.4 - Development in CO2 productivity by industrial branch, 2012-2019.

CO2 EMISSIONS FOCUS AREAS

The potential in the plastic, glass and concrete industries is huge. In 2019, the branch was responsible for 51 % of the combined industrial emissions. In the seven-year period of 2012-2019, productivity increased by 2 %, which was 35 % lower than CO2 productivity for the combined branches. The Food-, beverage-, and tobacco industries were responsible for 17 % of total industrial emissions in 2019, which, however, was 18 % lower than in 2012. Nevertheless, the branch was the second largest contributor of industrial CO2 emissions. The decrease in emissions means that CO2 productivity increased by 20 % from 2012 to 2019. This means that the branch has a relatively large impact, but that the potential for a large increase in productivity is smaller than before. The pharmaceutical industry increased its productivity by 200 % from 2012 to 2019 but was only responsible for 1 % of the combined industrial emissions in 2019. Thus, there is little potential for further growth in productivity as well as a potential impact. CO2 emissions from the furniture- and other industries were also responsible for 1 % of total industrial emissions in 2019. CO2 emissions decreased by 16 % from 2012 to 2019 and CO2 productivity increased by 64 %. This indicates that the branch is not of vital importance, but that there is still potential for improvement.

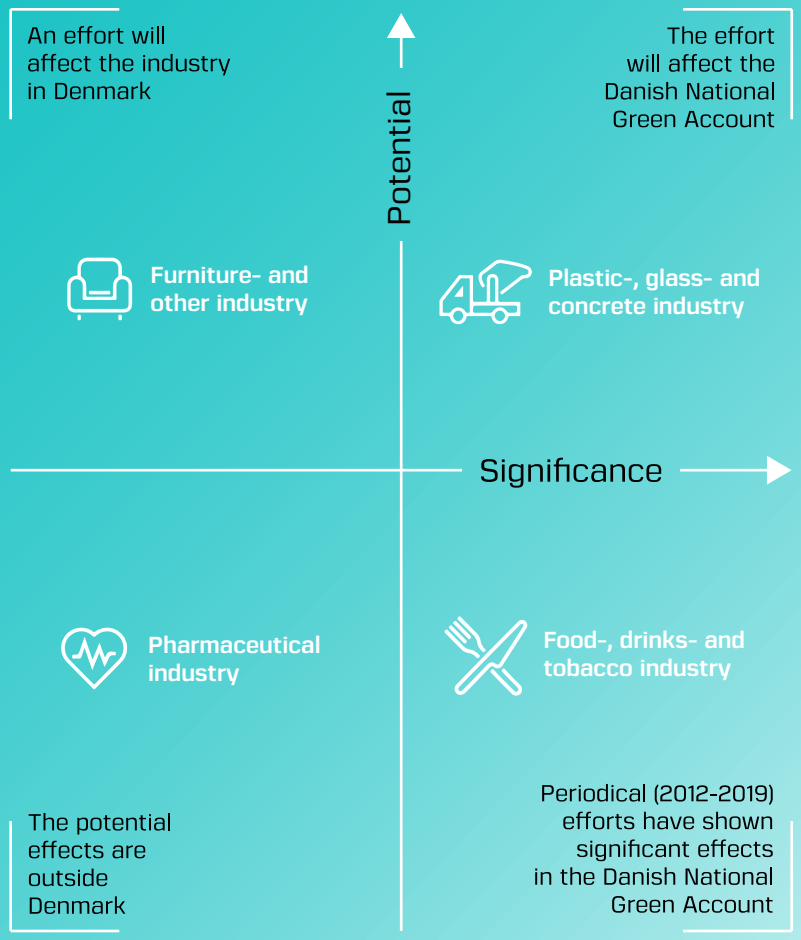


Figure 4.5 - Potential for and impact of branches' effort concerning CO2 emissions.

WASTE GENERATION

In this paragraph we introduce the baseline's data for industrial generation of waste in Denmark

- The absolute generation of waste by Danish industries was **1 million tons** in 2012
- In 2019, industry's absolute generation of waste was **1,2 million tons** - the highest measured in the 2012-2019 period
- The lowest generation of waste by Danish industries was measured in 2013 and amounted to **0,86 million tons**

WASTE GENERATION OF DANISH INDUSTRY

From 2012 to 2013 industrial waste generation decreased by 15 % and an absolute decoupling took place. From 2013 to 2019 there was a constant increase in industrial waste production and by 2019 the total increase amounted to 40 %. From 2016 to 2017 there was a relative decoupling, since gross value added increased more than waste production. From 2012 to 2019, waste productivity increased by 10 %. Figure 5.2 shows that absolute waste generation rose by 12 % from 2018 to 2019. It also shows that waste productivity decreased by 4 % from 2018 to 2019.

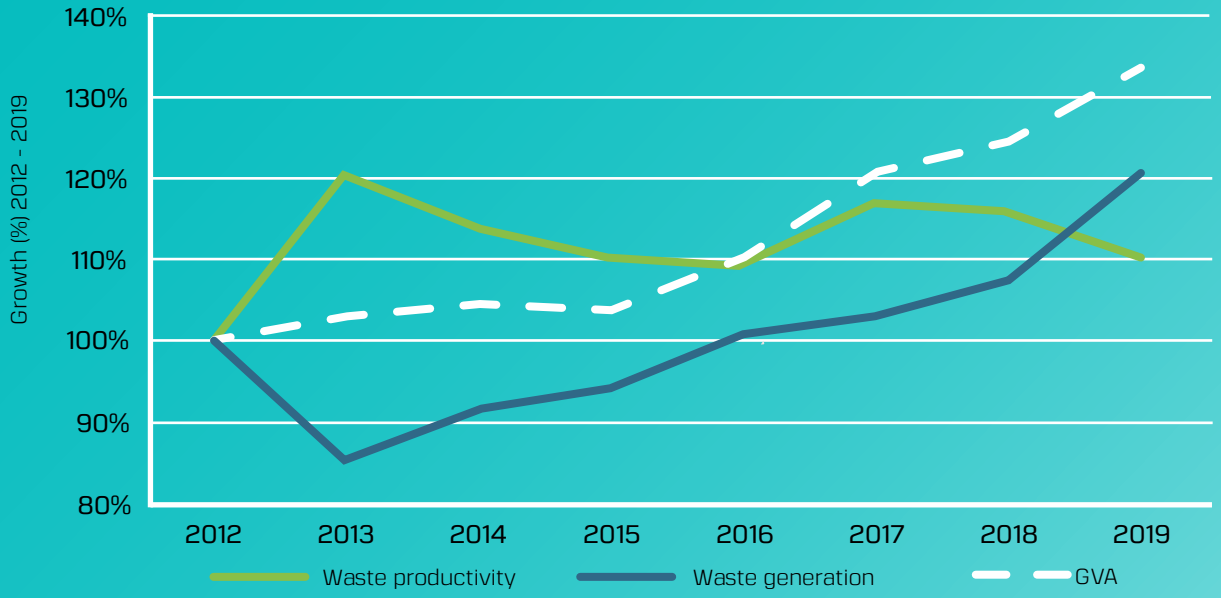


Figure 5.1 - Development in waste generation, GVA and waste productivity from 2012-2019 for industry as a whole.

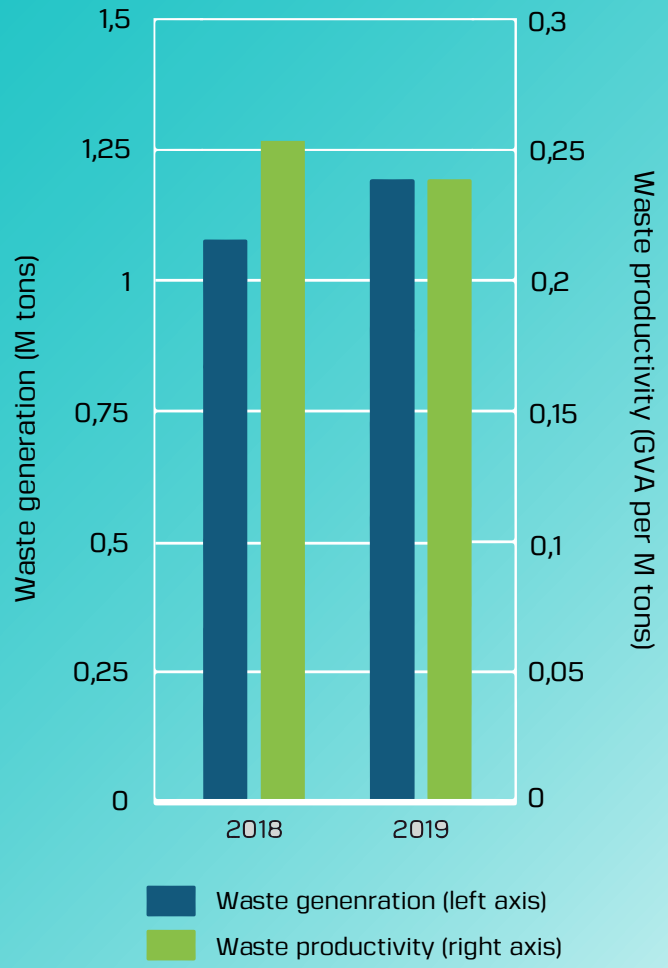


Figure 5.2 - Waste generation and productivity for industry as a whole in 2018 and 2019.

DEVELOPMENT IN WASTE GENERATION DISTRIBUTED BY BRANCH

The food, beverage and tobacco industries were the most waste-generating in both 2012 and 2019, and in 2019 the waste from that branch represented 25 % of the absolute waste production of the combined industrial branches. This was 61 % more waste than the metal industry and 54 % more than the plastic, glass and concrete branches produced in 2019. Despite the high amounts produced, the waste generation in the food-, beverage- and tobacco industries was reduced by 6 % from 2012 to 2019. Likewise, waste generation in the wood and paper industries and in the textile and leather industries decreased by 14 % and 5 % respectively. In the chemical and pharmaceutical industries, however, the waste degeneration increased from 2012 to 2019 by 212 % and 158 % respectively. In the other branches, waste generation increased between 7 % and 38 %.

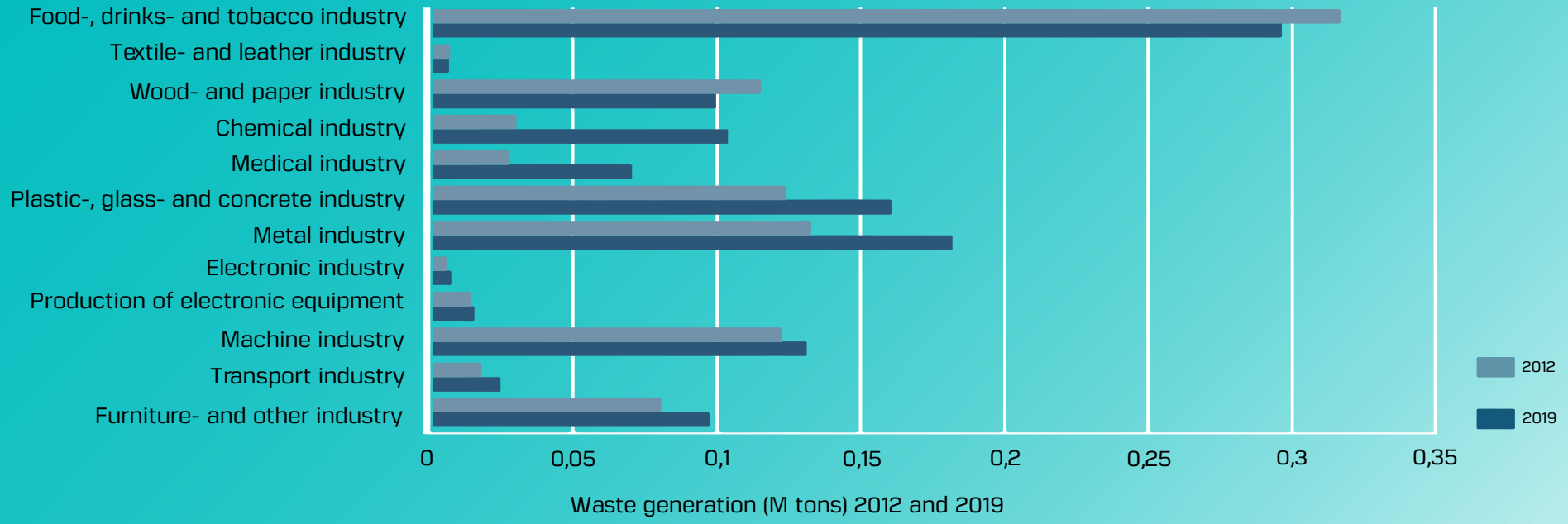


Figure 5.3 - Waste generation for various industrial branches in 2012 and 2019.

DEVELOPMENT IN WASTE PRODUCTIVITY BY BRANCH

Waste productivity within the industrial branches varies by up to 100 %. From 2012 to 2019, seven of the branches experienced a decrease in waste productivity. By far the largest decrease took place in the chemical and pharmaceutical industries, in which waste productivity decreased by 58 % and 27 % respectively. In the textile- and leather industries, waste productivity increased by 42 %, whereas the food-, beverage- and tobacco industries increased their waste productivity by 2 % from 2012 to 2019. Waste productivity in the chemical industry decreased conspicuously over the seven-year period and is remarkably different from the baseline for 2021. This may be due to different data being used to create the baseline, e.g. the category 'sludge', as listed in the chemical industry, represents a larger portion of the Green National Accountings than it did in data used for earlier years.

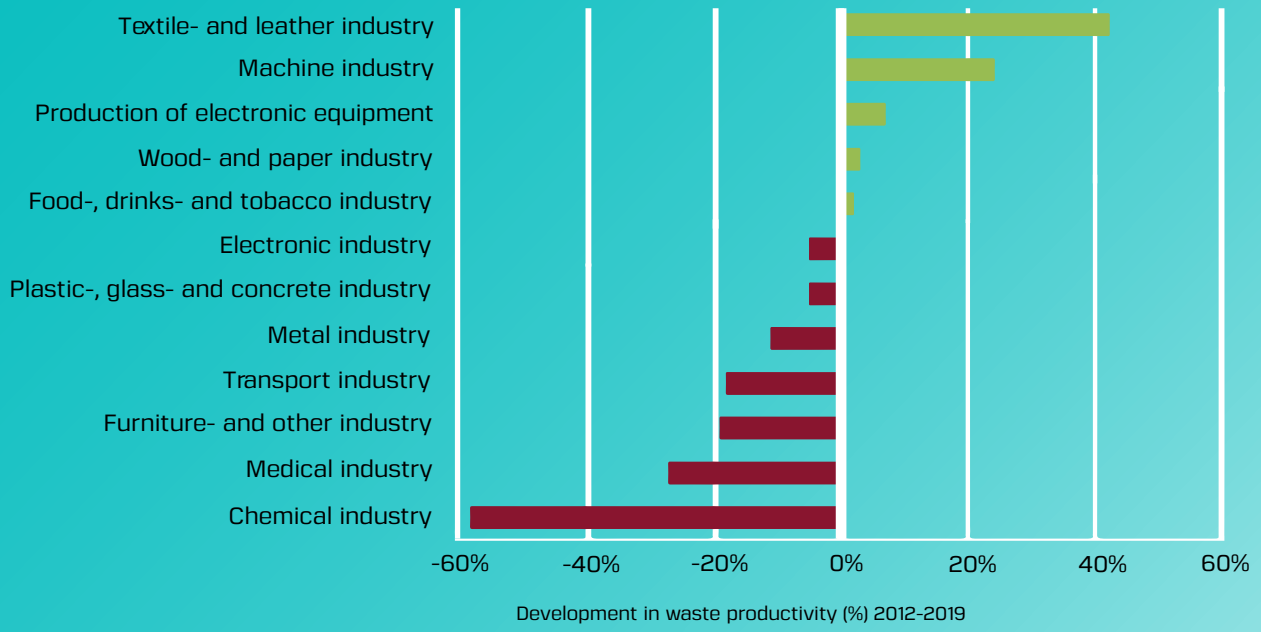


Figure 5.4 - Development in waste productivity by industrial branch, 2012-2019.

WASTE GENERATION FOCUS AREAS

In 2019, the pharmaceutical and the chemical industries were responsible for 6 % and 9 % of the combined branches' generation of waste. Over the seven-year period from 2012 to 2019, the generation of waste increased by 158 % and 246 % respectively, whilst productivity in the branches decreased by 27 % and 58 %. Therefore, there is significant potential for those branches. The same is true of the plastic-, glass- and concrete industries which were responsible for 13 % of industry's total waste generation in 2019. From 2012 to 2019, waste generation increased by 30 %, whilst waste productivity decreased by 5 %. The food-, beverage-, and tobacco industries were responsible for 25 % of total waste generation in 2019, and increased productivity by 2 % from 2012 to 2019. Hence, both the potential and importance are significant. In 2019, waste generation within the machine industry amounted to 25 % of industry's absolute generation of waste. From 2012 to 2019, waste generation increased by 7 % and waste productivity by 24 %.

Generation of waste from the textile- and leather industries decreased by 5 % from 2012 to 2019, and the branch succeeded in increasing productivity by 42 % over the same period. However, its contribution to total industrial generation of waste was only 1 %, which results in a small significance but larger potential.

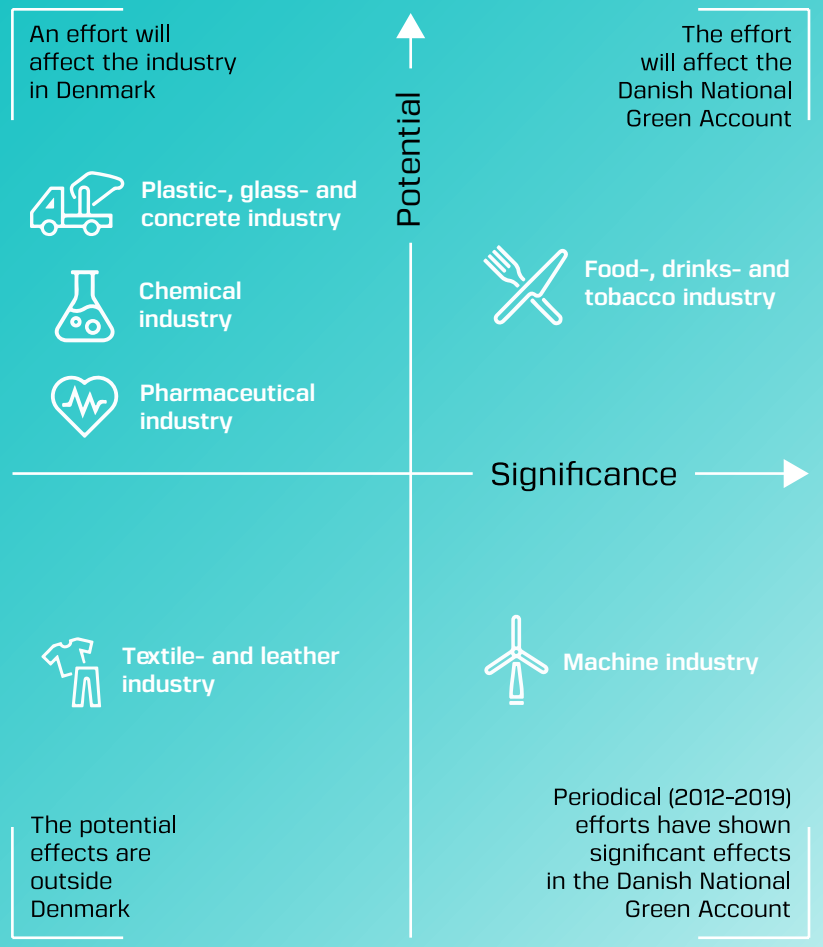


Figure 5.5 - Potential for and impact of branches' effort concerning waste generation.

FREMTIDENS BÆREDYGTIGE PRODUKTION

Working group – Fremtidens Bæredygtige Produktion

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