

'Greenhouse gases more explored'

The impact greenhouse gases are more than just CO₂, the Food Supply Chain needs restructuring

Anton Boonstra, September 2019

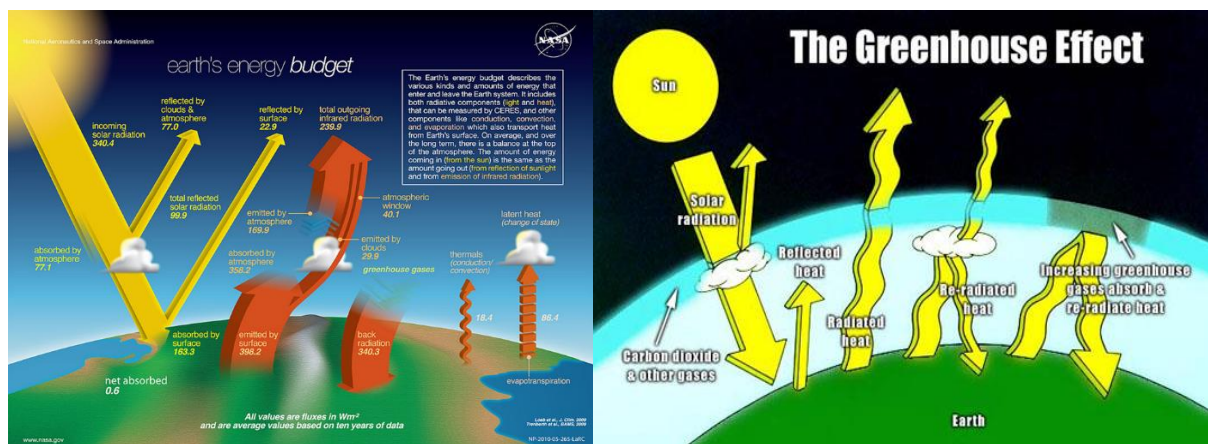
Introduction

The way we have designed our Food Supply Chain is contributing heavily to the Climate change. If we want to do something to reduce the Climate change, we need to understand what greenhouse gases exactly are? If I hear CO₂ for instance, is that the same? So, I thought I should explore a bit more what greenhouse gases are and what they do.

Then I want to find out who the big contributors are. Once you know who they're you could think on what they could do to reduce greenhouse gases. I discovered that Industry and Electric Power generation are the big contributors of CO₂, Agri&Food of CH₄ and N₂X (X stands for different combinations with Natium). We will see that Agri&Food in the Netherlands is importing and exporting a lot, in fact the 'own' consumption is relatively small. Netherlands is the 2nd largest exporter in the world. This means a lot of movement and transport of Food. We shouldn't do that. So, I will pleat for a revolution with the Food Supply Chain, we need to organize the Food Supply Chain radically.

So, in this article we will focus on green gasses, what they are and what they do. And we will focus on how we can reduce greenhouse gases in Agri&Food. Of course, we will touch how to reorganize the Food Supply Chain but in a new article I will dig into that deeper I promise you. So, for now what are greenhouse gases, what do they do and why do we need to reform the Food Supply Chain in order to reduce the production of greenhouse gases.

What are Greenhouse gases doing and why do we need to reduce them dramatically?



In a normal situation the sun is heating up the Earth. A part is reflected back into the 'open air'. But the greenhouse gases remain partly in the atmosphere around the earth and they form a kind of shield which reflects the warmth which isn't absorbed by the Earth. Because the warmth can't fully go into the space and remains in the atmosphere, the temperature in the atmosphere is rising. The atmosphere becomes warmer and warmer. This means less healthy nature, less wood, dry or too wet soil, less animals, less insects, The possibilities of absorbing the greenhouse-gasses are

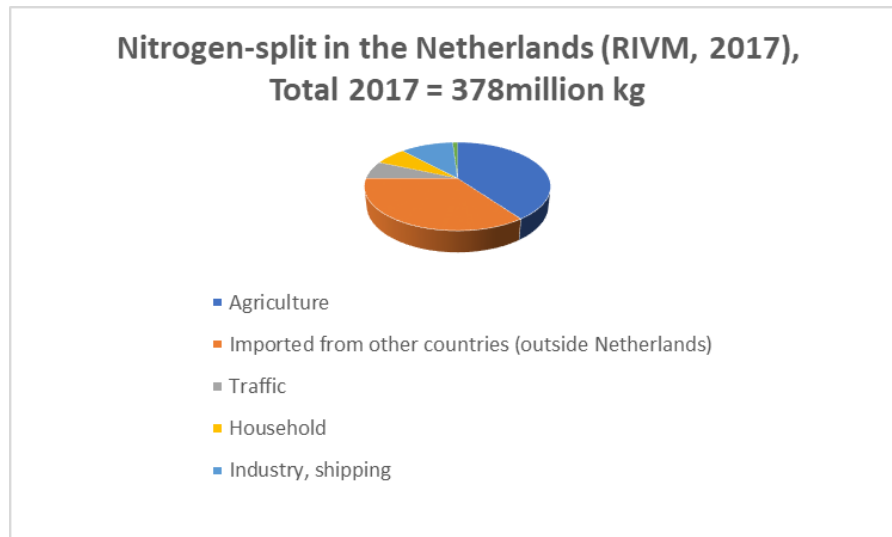
diminishing faster and faster. We are in vicious circle which only accelerates this process. We need to do something! On www.milieucentraal.nl, it's stated that in the last 140 years earth has been warmed up by 0.9 degrees Celsius. Of the last 16 years, 14 were warmer than ever before measured. I think for the most of us, this isn't really something new. It's clear we need to do something now to stop this vicious circle.

What green gases do we distinguish?

The most important greenhouse gases are:

1. CO₂ is the abbreviation of Carbon dioxide. CO₂ is stored in fossil energy-sources like gas, oil, coal and wood. It's freed up when it's burned or rotting. An average family is producing ca. 8000kg per year directly by commuting, transport. Indirect by buying food, furniture this average family is adding a 12.500kg per year additionally. So, in total an average family is responsible for adding 20.000kg CO₂ into the air every year again. To compensate this roughly 20.000kg you need 1000trees! This is hardly possible; therefore, we need to reduce the CO₂-emissions drastically.
The main CO₂-contributors are:
 - a) flying (one hour flight means roughly 400kg CO₂ emission per person);
 - b) driving our car (is 116gram per km CO₂ emission, so per year 25000km*0,116kg= 2900kg per year);
 - c) Meat (if you eat, as a family, meat every day, the whole year through, this means ca. 3000-3500kg CO₂ per year.Easy measurements would be don't go on holiday using a plane as much as possible, use an electrical car saves 70% emission, using a bike means even a 95% reduction, don't eat meat every day. Maybe we should set a goal to half CO₂-contribution and compensate the other half with at least 250trees.
2. Methane (CH₄) is mainly released by keeping cattle. Cows, sheep's, goats all produce CH₄ when they digest their food. CH₄ comes in the air by breathing, farting and belching. Also, rice (using water) and garbage processing are contributing CH₄. Because of the climate change water levels are generally lower or higher than before. If the water level is lower in swamp-areas, ground starts rotting and CH₄ is freed up during that process. Methane is a very strong green gas: 1 kilo methane has the same effect on the atmosphere as 28 kilo CO₂.
3. N₂x. Nitrogen is always present in large quantities (80%) in the air. In reaction with air or hydrogen it becomes for example Natrium-dioxide (N₂O) or Ammonia (NH₃) and some other linkages (N₂X), but N₂O and NH₃ are the bigger ones. Higher output of N₂O is mainly caused by traffic, the impact of diesel-cars is relatively higher. The impact on the climate change of 1 kilo N₂O is roughly 300times higher than 1 kilo CO₂. NH₃ is heavily increased by increased livestock. NH₃ is freed up from fertilizer. N₂O makes the biodiversity lesser. Certain plants love N₂O but most of them don't. NH₃ makes the soil sour which has also an impact on the biodiversity.
4. Water vapour is also one of the greenhouse gases, very often not shown in the statistics. Seems harmless and in fact that's true, but the problem of water vapour is that by warming-up the earth, the percentage of water vapour is increasing as well. Warmer air means more water vapour present. So, water vapour helps increasing the warmth in the atmosphere around the earth.

5. There are also some other greenhouse gases like the Fluor gasses (HFK's, PFK's) which are in siphons, aircon's and refrigerators. Fluor gasses are very strong, they're reduced the last years and became less a problem. Luckily they form a lesser problem nowadays.



So, greenhouse gases are responsible for warming-up the Earth. Greenhouse gases is more than just CO₂. Also, Methane, Nitrogen and Water vapour are important contributors. Maybe their volumes are less but their impact is bigger. These gases are grouped into greenhouse gases because they contribute to the shield within the atmosphere around the earth. The temperature within the atmosphere is rising and rising, 'our' climate on earth is changing. In the next paragraph we will explore a bit more who is contributing to which greenhouse-gas. We need to analyse this a bit more in order to understand what the key to the solution is.

Who are the main contributors to the rise of greenhouse-gasses?

In the next picture you can see a split per sector, the evolution of the volumes of the 'main' greenhouse-gasses produced during the years 1990-2018:

Source: <http://www.emissieregistratie.nl/erpubliek/erpub/international/broeikasgassen.aspx>

Nationale Broeikasgasemissies volgens IPCC

In de onderstaande tabel zijn de indirecte emissies inbegrepen. De totale broeikasgasemissies zijn exclusief de emissies van Land Use, Land Use Change and Forrestry (LULUCF).

Broeikasgasemissies in Mton CO₂-eq van 1990 t/m 2017, vastgesteld in januari 2019

2018*: voorlopige cijfers vastgesteld in juli 2019

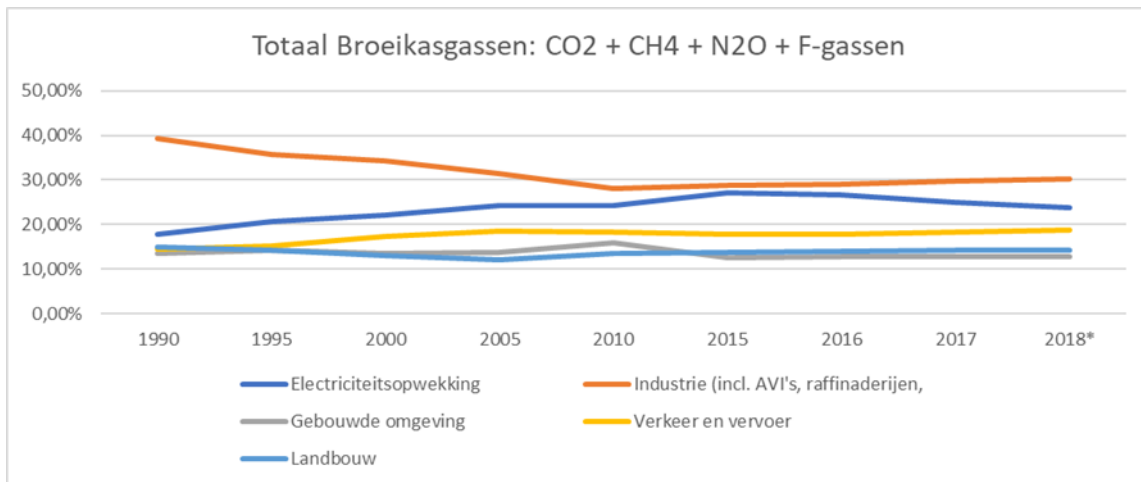
[\(zie verklaring ontwikkeling emissies\)](#)

Sectoren klimaatbeleid	1990	1995	2000	2005	2010	2015	2016	2017	2018*
Electriciteitsopwekking									
CO ₂	39,5	47,6	48,2	51,9	51,8	53,1	51,9	48,3	45
CH ₄	0,04	0,06	0,07	0,1	0,11	0,08	0,09	0,08	0,08
N ₂ O	0,11	0,12	0,11	0,15	0,14	0,17	0,16	0,14	0,12
Totaal	39,6	47,8	48,4	52,1	52	53,3	52,2	48,5	45,2
Industrie (incl. AVI's, raffinaderijen, winningsbedrijven)									
CO ₂	54,9	50,6	50,4	50,7	49,7	48,5	49,1	50,4	50,1
CH ₄	16,3	14,6	10,9	7,5	5,7	4,4	4,2	3,9	3,7
N ₂ O	7,3	7,4	7,2	7	1,8	1,9	1,8	1,8	1,7
F-gassen	8,5	10,1	6,8	2	2,7	1,6	1,7	1,6	1,8
Totaal	87	82,7	75,3	67,3	60	56,4	56,7	57,7	57,2
Gebouwde omgeving									
CO ₂	29,1	32,2	28,8	28,6	33,1	23,9	24,3	24	23,8
CH ₄	0,6	0,7	0,7	0,6	0,7	0,5	0,5	0,5	0,5
N ₂ O	0,3	0,2	0,2	0,1	0,1	0,1	0,1	0,1	0,1
Totaal	29,9	33,2	29,7	29,3	33,9	24,5	24,9	24,6	24,4
Verkeer en vervoer									
CO ₂	31,9	34,9	37,5	39,2	38,3	33,9	34	34,6	34,8
CH ₄	0,21	0,15	0,11	0,09	0,08	0,07	0,07	0,07	0,07
N ₂ O	0,13	0,28	0,31	0,28	0,29	0,27	0,26	0,27	0,27
F-gassen	0	0,01	0,12	0,31	0,42	0,46	0,47	0,47	0,47
Totaal	32,3	35,3	38	39,9	39,1	34,7	34,8	35,5	35,6
Landbouw									
CO ₂	8	8,4	7,6	7,6	9,7	7,5	7,5	7,6	7,6
CH ₄	14,7	14,2	12,5	11,5	12,9	13,2	13,5	13,5	13
N ₂ O	10,2	10,1	8,3	7	6,2	6,3	6,2	6,4	6,3
Totaal	32,9	32,7	28,5	26,1	28,8	27	27,2	27,4	26,9
Totaal									
CO ₂	163,3	173,7	172,5	178	182,6	166,9	166,8	164,9	161,2
CH ₄	31,8	29,7	24,3	19,9	19,4	18,2	18,3	18	17,3
N ₂ O	18	18,2	16,2	14,6	8,6	8,8	8,5	8,7	8,5
F-gassen	8,5	10,1	6,9	2,3	3,1	2,1	2,2	2	2,2
Totaal	221,7	231,7	219,8	214,7	213,8	196	195,8	193,7	189,3

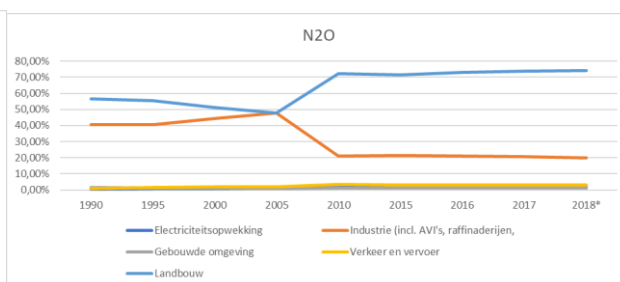
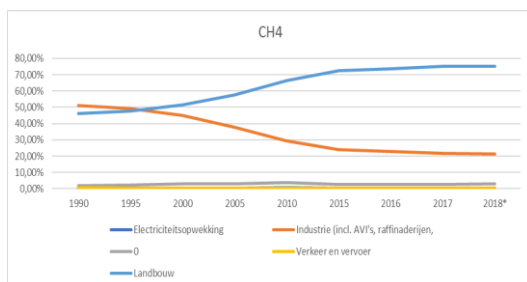
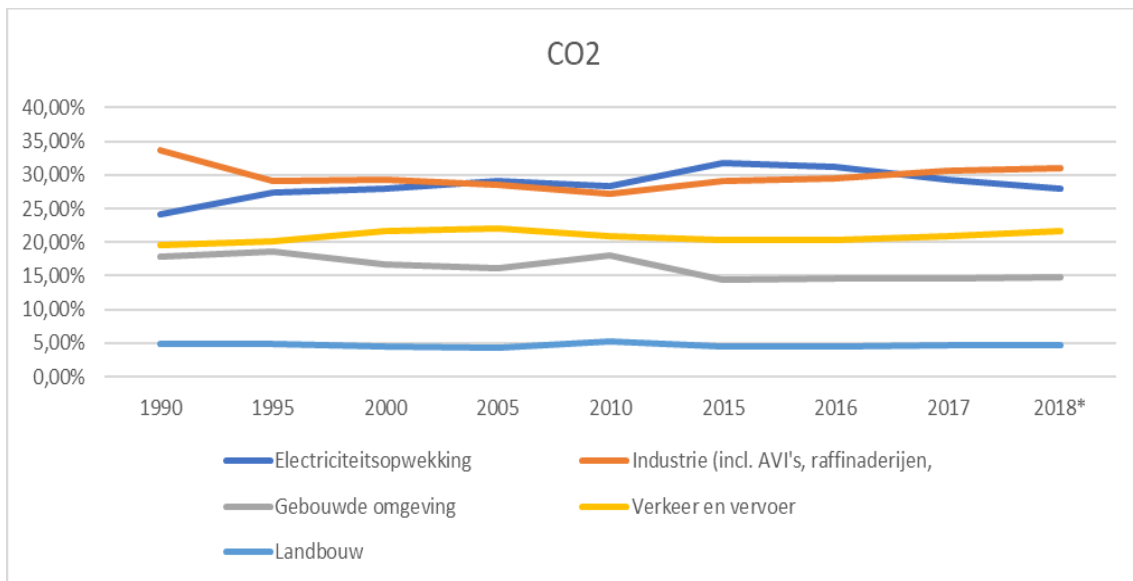
If you look at the totals per greenhouse gas you could say ca. 160 Mton CO₂-equivalents representing 85% of the total greenhouse gases in 2018 is CO₂-emission. So, 'our' focus should be to reduce CO₂ first dramatically. If we go into somewhat more detail and use following picture (based on the figures above), sub conclusions are:

- Industry reduced greenhouse-gasses substantially between 1990 and 2010 and stabilized around 30% around 2010. But with 30%, the industry is still the major contributor of the five sectors distinguished.
- For me surprising is the rise of the electricity companies. They went up from a 18% in 1990 to 29% in 2015 and declined a bit after those years until 2018.

- Traffic went up very slowly through the years from 12% to 19% in 2018
- Agriculture and households are almost on the same level but not that big as you think if you listen to the political debates.



If you focus just on CO2, you don't see much evolution from 2010 onwards. Household is clearly going down. But also, here you can see that agriculture is the least contributor to CO2 of the five distinguished sectors. Generating electric power and industry are clearly the biggest contributor, transport is in the middle:



If you see the graphs of just CH4 and N2O emissions, you see that agriculture is a big contributor and it was rising substantially since 2005-2006 which is caused by letting loose the milk quota and the

maximum amount of pigs you're allowed to have. It's good to see that industry reduced their shares dramatically in the good direction. But clearly a huge problem for CH₄ and N₂O-emissions is caused by agriculture.

Conclusions: -

85% of the total greenhouse gases is CO₂, being the biggest problem! So we should really tackle this issue first. The shares of Industry and Electrical power stations in total CO₂ emissions are the highest and still rising. So first actions to reduce the CO₂ emissions should clearly come from them. We know transport is an important contributor as generating Electric power based on burning fossil material.

Agriculture is the main contributor to CH₄ and N₂O emissions and substantial rising since 2005-2006. Let's first dig a bit deeper into the Agriculture and then special on animals/meat to understand the 'agricultural' share of CH₄ and N₂O.

Sidestep to Agriculture to understand where the high share CH₄ and N₂O is coming from

Let's start first with 'livestock and meat' and then we take it a bit broader within Agriculture.

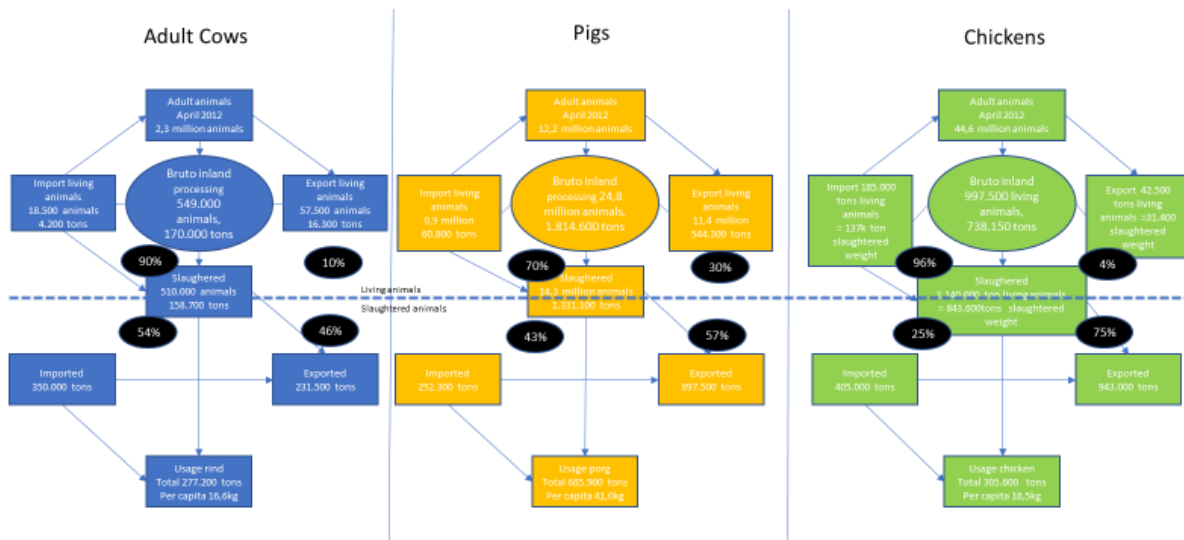
Livestock and meat

The 3 main groups of animals we keep in the Netherlands (17million inhabitants) are:

- 1,7 million cows (causing 57% of the Nitrogen contribution of Agriculture total)
- 12,5 million pigs (causing 17% of the Nitrogen contribution of Agriculture total)
- 100 million chicken (causing 9% of the Nitrogen contribution of Agriculture total)

Why are these numbers so high? You know for sure that these quantities can't be just for consumption. The answer is: Netherlands is importing and exporting a lot of animals! In a report (published in 2013 over the year 2012 by Productschap pluimvee & eieren and Productschap voor vee & vles) you can find some interesting pictures combined with facts figures. Focus is on the biggest 'subgroups' within meat and animals: -

'Meat-logistics' in the Netherlands: cows, pigs and chicken



Source: uitgave productschap pluimvee & eieren en productschap vee & vlees, 2013, translated by Anton Boonstra, 2019
The black 'rounds' are calculated by Anton Boonstra

The different colours are used to differentiate the three main groups: Adult cows, pigs and chickens. Vertically you see a split (in picture by dotted line) between livestock and slaughtered material.

Conclusions from this picture are: -

- Livestock:
 - o Import activities on adult cows and pigs are limited. Import on chickens more substantial (19%).
 - o Export activities pigs major with 30%
- Slaughtered animals
 - o On all 3 categories import and export are high. On cows you have the strange situation that you import twice as much as the output of your own 'processing', to export 46% again. So, it's more trade than inland processing. With pigs the import is within reason (15%) but the export is 57%!! On chicken the import is 32% and the export is even more 75%.

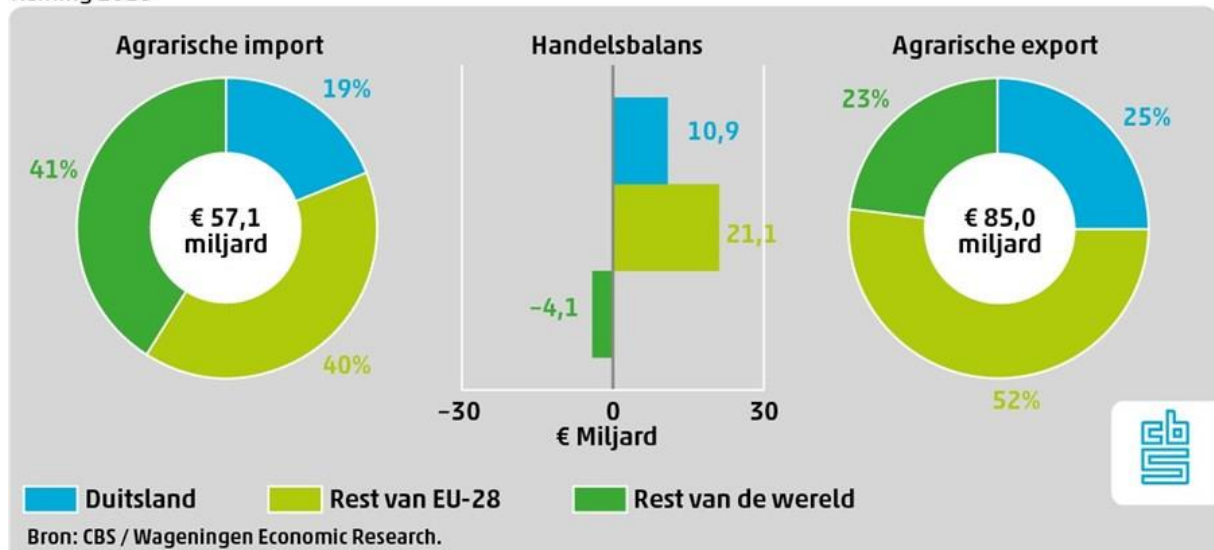
What the picture also shows is the quantities which remains in the Netherlands isn't that much. You could say a lot is imported; a lot is exported. It's more trade then own consumption.

Agri&Food

If you look at Agri&Food as a total (so including flours, vegetables etcetera) we can also conclude that the impact of the agricultural activities on the Dutch economy is high and really substantial.

Handel in agrarische goederen naar herkomst en bestemming

Raming 2016



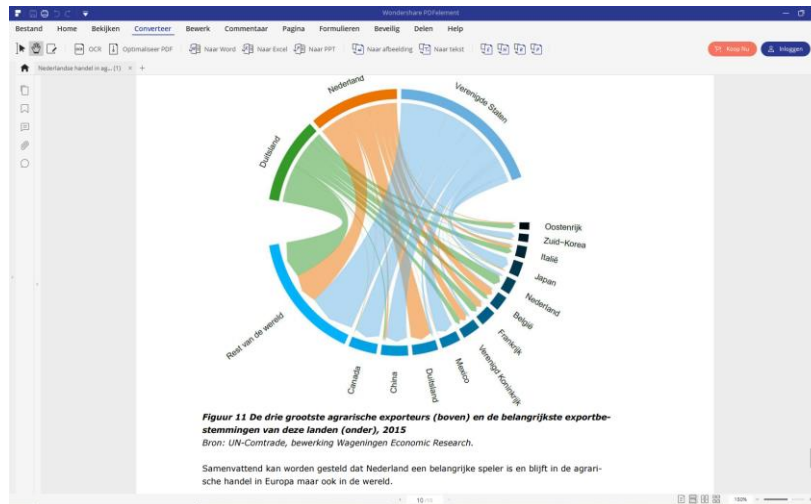
The total Export of the Netherlands was in 2016 427 billion euro's, total import around 376 billion euros. So, the total positive difference is 51 billion euros. Although the total Agro&Food sector Netherland is only 20% of the total export its contribution to the trade surplus is 55%. So Agro&Food business is an important contributor to the Dutch economy.

The following pictures show that the Netherlands is the second biggest exporter of agriculture products. Nr1 is the US and Nr3 is Germany. If you look in more detail on this picture you can also see the thick flows to Germany UK France and Belgium but also to the rest of the world. The linkages between Germany and The Netherlands are quite strong.



Conclusions on Agricultural activities within the Netherlands

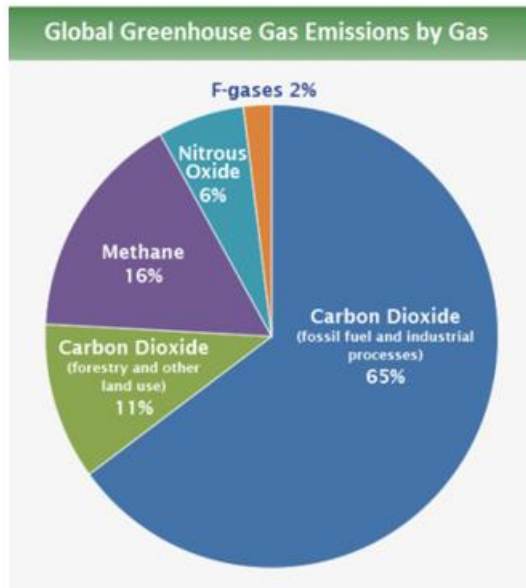
Agriculture isn't contributing a lot to CO2 locally but has the biggest share in CH4 and N2X. This is caused by keeping too many animals certainly if you relate that to the 'own' consumption. Reason for having so many animals is the big import and export activities. If you look at the total agricultural activity, The Netherlands is the 2 biggest Exporter of the world!!! This in itself causes a lot of CO2 in other countries which isn't reflected in the figures above because this is just figures in the Netherlands. So, if we want to reduce greenhouse-gasses we really need to size down the import and export 'agricultural' activities. We need to redesign the Food Supply Chain!



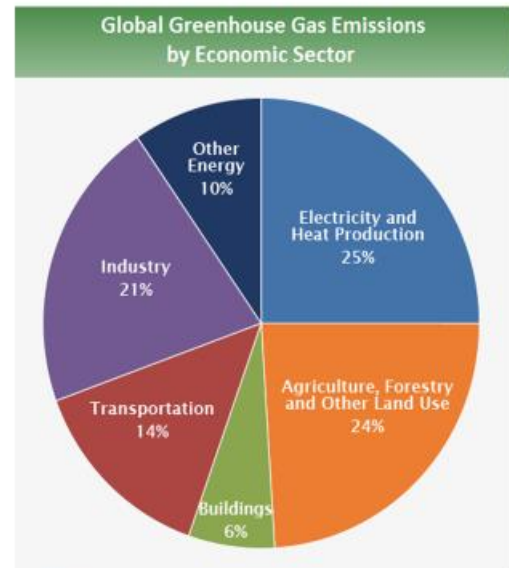
Why did we organize the Food Supply Chain the way it is today?

What's the reason to grow a pig in the Netherlands to export the animal to China for instance? Can't China not grow their own pigs? It's all about trade and prices partly disturbed by subsidies. Really there is no real reason to do so. What happened is that in the Food Supply Chain we applied the same principles as in other industries like automotive or electronics for example. But that's different. Building a car is something you can't do next door, you need machines, you need scale etcetera. To a certain extent you can defend that concentration makes sense. But in Food&Agri that's only partly true. If you want to make sugar for example you need a factory of certain scale. But to grow vegetables for instance the nearer to home the better. Therefore I have introduced a model of thinking called: 'everyone a vegetable garden'. Like said this is a model of thinking because it's not realistic of course, but taking a vegetable garden as starting point is very good I think. You should apply the lean-methodology to it. So why might a farm with just one or two different species be useful. Because it's efficient of course, but if you add the transport costs to it and then the cost of environmental aspects, it becomes different. So my plea would be to keep food as local as possible.

Globally emissions



Source: IPCC (2014) based on global emissions from 2010. Details about the sources included in these estimates can be found in the Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, IX.11



Source: IPCC (2014) based on global emissions from 2010. Details about the sources included in these estimates can be found in the Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, IX.11

Globally figures are confirming what is said before local Netherlands. If we focus on the Food Supply Chain and assume the Food Production is roughly 10% of the total production (at least in the Netherlands), then you could state: (agriculture, 24%) + 10% (remaining, 76%) = 32% of the greenhouse gases are caused by the Food Supply Chain! Do I need to say more?

So what do we need to do?

So, the biggest problem is caused by industry, transport and agriculture. We do as if that something outside us. All these things happen because we are the consumers. Basically it's very simple. We should buy as consumers very local. We should stop with importing and exporting food. Of course there will be always certain products which are difficult to grow in the Dutch climate, but the general rule should be: buy and produce local unless ... Of course there will be people saying you're ruining the economy. I don't think so, if we pay a fair price for our goods, it shouldn't be a problem. So the solution is simple, only coming there ain't easy, I know.

I think we should start changing the mindset and then we should start changing the Food Supply Chain

1. Change the Mindset

The mindset should be that we shouldn't move around Food that much. One of the wrong thoughts is that we copied the automotive/electronic sector too much. Food you should get as near to you as you can, with electronics or automotive that's impossible. You can't make a vacuum cleaner or a car just around the corner. But with Food that's possible.

The idea of 'everyone a vegetable garden'



Smaller scale

Bigger scale

Everyone a vegetable garden

Cluster of people owning a garden, wether or not with a farmer fulltime employed

A farmer within a radius of 20km max delivering to a certain address in the neighbourhood (supermarket, grocer, ...)

Example of www.heerenboeren.nl with ca 200 consumers you own a piece of land on which also a farmer is fulltime employed and consumer support this farmer in turn for a piece of the crop.



So therefore, I started to call the change of mindset 'everyone a vegetable garden' because we need to think before we get something from very far.

Beneath a nice picture I found on the internet summarizing what we can do to reduce the greenhouse gases. I will focus more on the need to change the Food Supply Chain dramatically.



2. But what we really need to do is changing the Food Supply Chain

The current Food Supply Chain

A bigger manufacturer has more sites in a country. Very often this is the result of mergers. Originally the sites were producing similar products on similar lines but after

a merger an easy efficiency measurement is to keep the sites but produce one product on one site. Many big companies do that even cross border and call that produce international to sell local, in short 'international for local'. So, one product is produced on limited sites somewhere on the globe and then send to a DC somewhere in a country. That DC is than sending the stuff to an outsource party or directly to a Retailer. A retailer has mostly one central DC for the slow-moving products and regional DC's for the fast movers. Every Retailer has similar structures. I don't want to go to much in detail here, but what I want to make clear is that this are the common structures within the Food Supply Chain. There are a lot of links within the Food Chain (from production to DC, to outsource DC, to DC of Retailer, to shop). Too many I think, this explains also the enormous transport-movements. These structures need to be changed.

The future starts with: 'Everyone a vegetable garden'

I have introduced the saying "everyone a vegetable garden' because it's a frame for thinking smart. We should start with the basic question why do we have to get the product from so far? For some products it makes sense but for a lot it doesn't. Certainly, in the case of vegetables and meat it isn't really necessary. So, use the thinking frame I have introduced.

For instance, you could organize supermarket like petrol-stations. The government allows in a certain area with a certain population on a certain m2 a supermarket, regardless the brand-name. Let's the retailers fight who wants to be responsible in that area. Then we should try to get people more involved in growing their own vegetables and meat. But when they decide they want to rely on farmers, only certain farmers within a range around that supermarket are allowed to deliver that supermarket. Or maybe we should introduce the baker and the greengrocer again. Why should vegetables and meat pass the supermarket? It's just adding a link to the chain again. This is just a way of thinking; we need to discuss more in detail and bring it further, but I would say that's the starting point. In a next article I will elaborate this idea a bit more.

Overall story

Greenhouse gases isn't just CO₂ but also CH₄ and N₂X. The biggest contributors of CO₂ are power generating companies and industry. The biggest contributor of CH₄ and N₂X is agriculture and is coming mainly from animals.

If you take agriculture a bit broader, Agri&Food is responsible for roughly 30% of the total greengasses. We need to size that down dramatically.

In the end power generation, industry and agriculture are producing for us, consumers. We need to start a different mindset: use and produce only local. So stop importing and exporting, stop those ridiculous transports of meat to China or buying meat from South-America.

We need a shift in mindset and then we need to restructure the Food Supply Chain so we minimize moves and transports over the world. Only in that way we can save our Earth.

