Green Competition

Is Denmark among the best climate nations?

Nowadays, everybody wants to be green. The Danish prime minister has declared Denmark to be “one of the best climate nations in the world” (fig. 1). This note explains why this is an exaggeration.

In terms of emission intensities by economic activities, the best nations in Europe are Switzerland, Sweden and France. Denmark is somewhere in the middle, slightly worse than the EU average.

Danish GHG[1] Emissions per capita above EU Average

The Danes like news about Danish achievements, but the green ad (fig. 1) from the leading party in the Danish government goes too far. It is easily disclosed. Reality is more faceted.

Fig. 1 – “...one of the world’s best climate nations”?

The Eurostat database[2] was used in an attempt to quantify the Danish performance. The database is comprehensive and complex. A reservation for possible misinterpretations in this paper must therefore be made.

The database includes a table with “Greenhouse gas emissions per capita” (Eurostat t2020_rd300). It has data for each year from 2000 to 2015.

In terms of GHG emissions, the Danish position among the European countries is not impressive. The Danish emission in 2015 was 9.0 tons CO_2 equivalent per capita (fig. 2 and 3). The EU average was 8.7 tons.

There are interesting differences between the countries. The international comparison in fig. 3 covers a range from about 5 tons per capita to over 20 tons per capita.

Norwegian emissions per capita are about twice the Swedish emissions. In both countries, electricity production is practically without emission of greenhouse gas.

Other comparable countries have remarkable differences. Each country has probably a good explanation of its particular position. Other Eurostat tables will help us to see the GHG emissions from different angles.

[1] GHG: Greenhouse Gas
[2] http://ec.europa.eu/eurostat/data/database

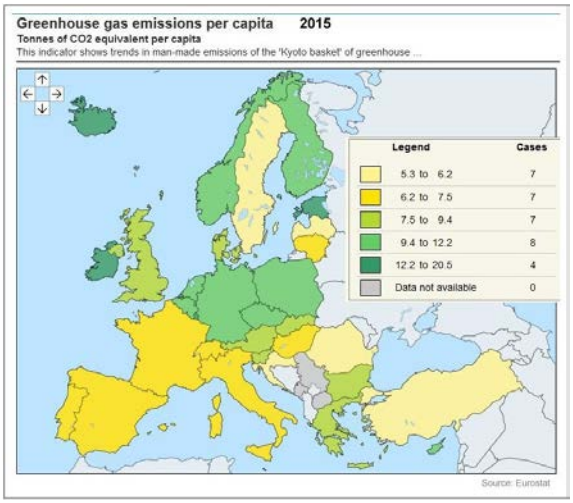


Fig. 2 – Map of Europe, generated by Eurostat

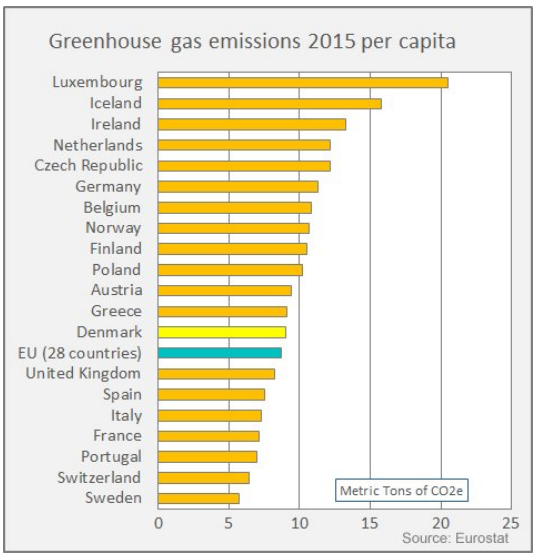


Fig. 3 – Greenhouse gas emissions 2015 for a selection of European countries

Increasing Global Emissions

Wikipedia has a global comparison of greenhouse gas emissions per capita for the years 1990 to 2013. The Danish emission was 9.38 tons CO_2 equivalent per capita in 2013. The world average was 6.27 tons. The EU average is higher (in 2013 45%) than the World average.

The Danish emission was reduced by 28% since 1990 (or 1.4% per year), while the global emission increased by 12% (or 0.5% per year). There is no sign of a global improvement. Since 2000, the average global increase per year was 1.1%.

Rating Climate Efficiency

Three main folders with 25 tables on GHG emissions were found in the Eurostat database (see annex 1).

Eurostat has collected statistics from different sources (annex 2). Different definitions have been used for different types of statistics. The two main types are:

- '*Air emission accounts*' by Eurostat (Based on *economic activities*, following the NACE classification of the system of national accounts.)
- '*GHG emission inventories*' by UN (Based on *emission location*. Fuel for ships is assigned to the country, where the fuel was bunkered)

A third type, called '*footprints*', classifies GHG emissions by final use of products. The footprints are not used in this note.

The results in fig 3 are based on *emission inventories*. Emissions from Danish ships and aircrafts, having bunkered abroad, are not included.

There are two tables with total emissions in emission accounts, "Air emissions accounts by NACE Rev. 2 activity" (Eurostat env_ac_ainah_r2) and "Air emissions accounts totals bridging

to emission inventory totals" (Eurostat env_ac_aibrid_r2). The last one, which also includes emissions from households, has been used for fig. 4.

It is possible to extract a specification for each country and for each year. The tables in annex 3 show breakdowns of Denmark's GHG emissions from emission inventories (table 1) and emission accounts (table 2).

The construction of a counterpart to fig. 3, based on emission accounts, requires a table with the size of the populations. It was found in "Population on 1 January by age and sex" (Eurostat demo_pjan).

Countries with high economic activities per capita seem to flock in the top of the list. Economic activities seem to cause emission of greenhouse gas.

GHG emissions are higher for Denmark in emission accounts than in emission inventories and lower for most other countries. It puts Denmark in a less favourable position in comparison with other European countries (fig. 4).

Eurostat offers an alternative table: "Air emissions intensities by NACE Rev. 2 activity" (Eurostat env_ac_aeint_r2), GHG emissions by economic activity (fig. 5).

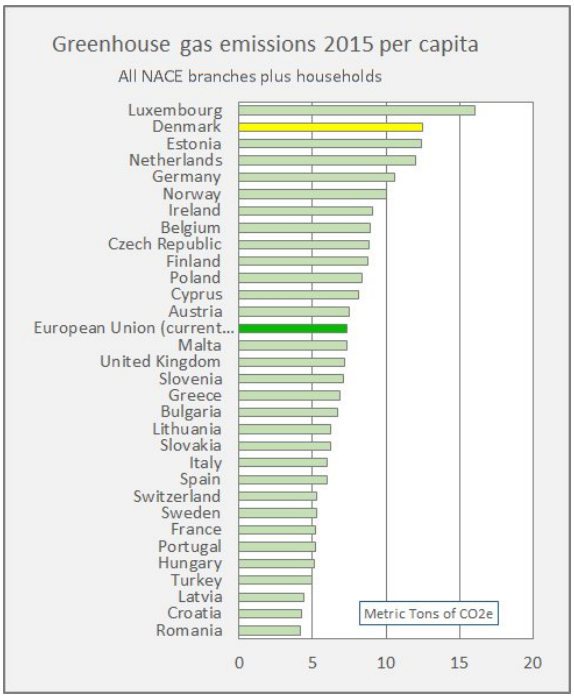


Fig. 4 - Emission accounts including households

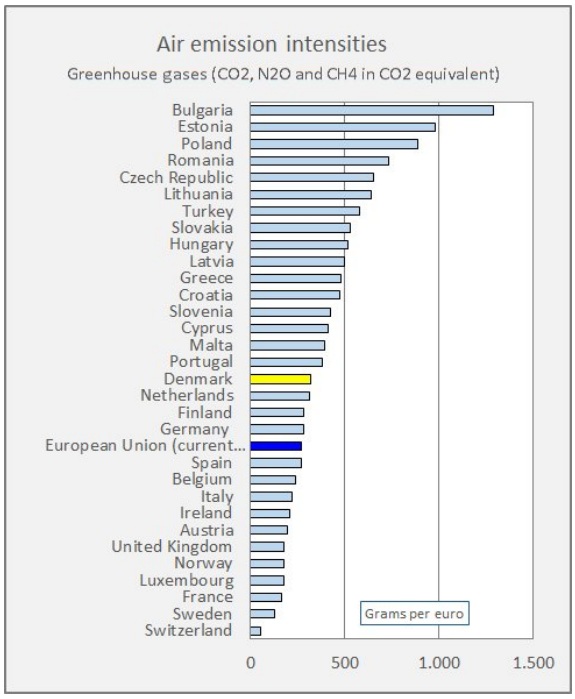


Fig. 5 - Emission intensities per euro

Fig. 5 can be interpreted as **climate efficiency**. It practically turns the list in fig. 4 upside down. Switzerland, Sweden, France and Norway are among the most climate efficient countries. Bulgaria, Estonia, Poland and Romania are the most inefficient countries. Denmark is somewhere in the middle, slightly less efficient that the EU average.

This rating seems to be realistic, but it does not qualify Denmark as one of the world's best climate nations.

The EU Reduction Targets

EU does not set targets for the emission per capita, but for the emission reductions. The target for 2020 is a 20% cut in GHG emissions (from 1990 levels). The Member States are required to limit their GHG emissions by meeting binding annual limits, which are set according to a linear path. Some flexibility is allowed by moving emissions between years and between member states.

Eurostat t2020_30 shows emission indices with 1990 as the base year.

The total EU emissions (28 countries) in 2015 were 78% of the emissions in 1990. The 80% target in 2020 seems to be met already in 2015. According to fig. 7, most of the reduction has taken place since 2005. Fig. 7 also demonstrates large variations from year to year and between countries. However, the main trend is clear.

While Denmark's GHG emission per capita in 2015 was above the EU average, the Danish emission reduction since 1990 is better than the EU average (fig. 6). However, this is not enough for making Denmark one of the world's best climate nations.

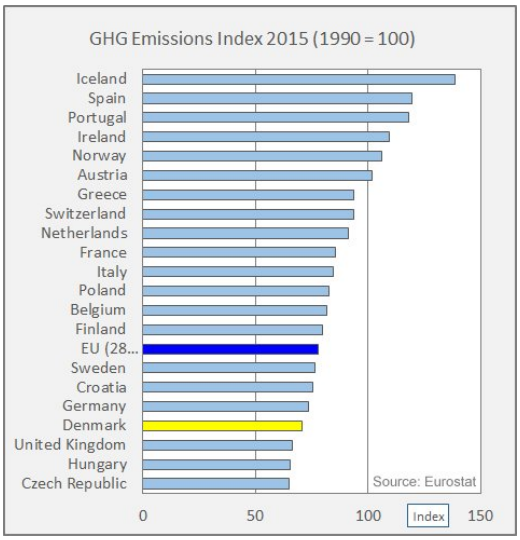


Fig. 6 - Danish reduction 2015 among the best

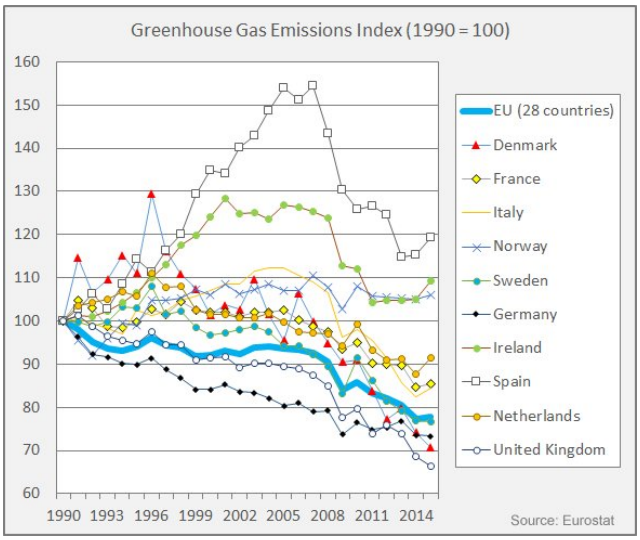


Fig. 7 - Large international differences

The more Wind Farms the better, or?

The Danish government has issued a new energy proposal[3] in order to make Denmark a more green country. The proposal includes several elements, including a new 800 MW offshore wind farm.

The opposition parties have responded by outbidding the proposal. The public debate leaves the impression that the green future is mainly a matter of more offshore wind farm capacity. The more the better.

However, the wind power output does not fit with the electricity demand profile. The idea of changing the electricity demand pattern to follow the wind power output has been discussed for at least 20 years, but with very poor results so far. In the commercial world, investments

[3] http://en.efkm.dk/energy-and-raw-materials/energy-for-a-green-denmark/

in new production facilities would usually be based on a reasonable expected demand for the output, but a political process does not require such considerations.

All political parties agree that research and development should pave the way for the transition into a green future. Wind and solar power are non-controllable, but sufficient importance was never attached to the balanced development of the supply and demand sides of the energy systems.

The GHG emission from electricity and CHP supply in 2015 was about 15% of the total Danish GHG emission. Other initiatives than new wind farms will be required for the remaining 85%.

It is uncertain, to which extent bio-fuels are sustainable and climate neutral. The advantages of bio-fuels for electricity production are that the electricity output is controllable, and that it can support a continuation of the Danish tradition for CHP (combined heat and power). Bio-fuels also have a huge potential for research and industrial development.

It takes a balanced development of a number of elements of the energy system to meet different targets, such as security of supply, economy and climate. However, the focused political race for more wind power suggests that it is more important to polish a green image than to reduce Danish GHG emissions.

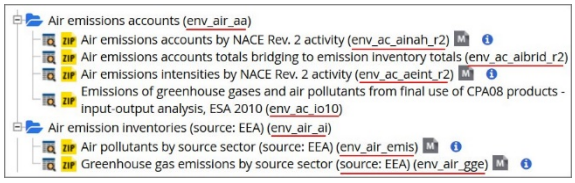
Annex 1

Navigation in the Eurostat Database

To open the database start page with the data structure (fig. 8):
http://ec.europa.eu/eurostat/data/database

Different tables with GHG emissions have been stored in three folders under “Data-base by themes”, “Tables by themes” and “Cross cutting topics”.

A code is attached to sub-folders and files:



A table can usually be found directly by googling “Eurostat” and code, for instance:
eurostat env_air_gge

The database offers a selection of download formats:

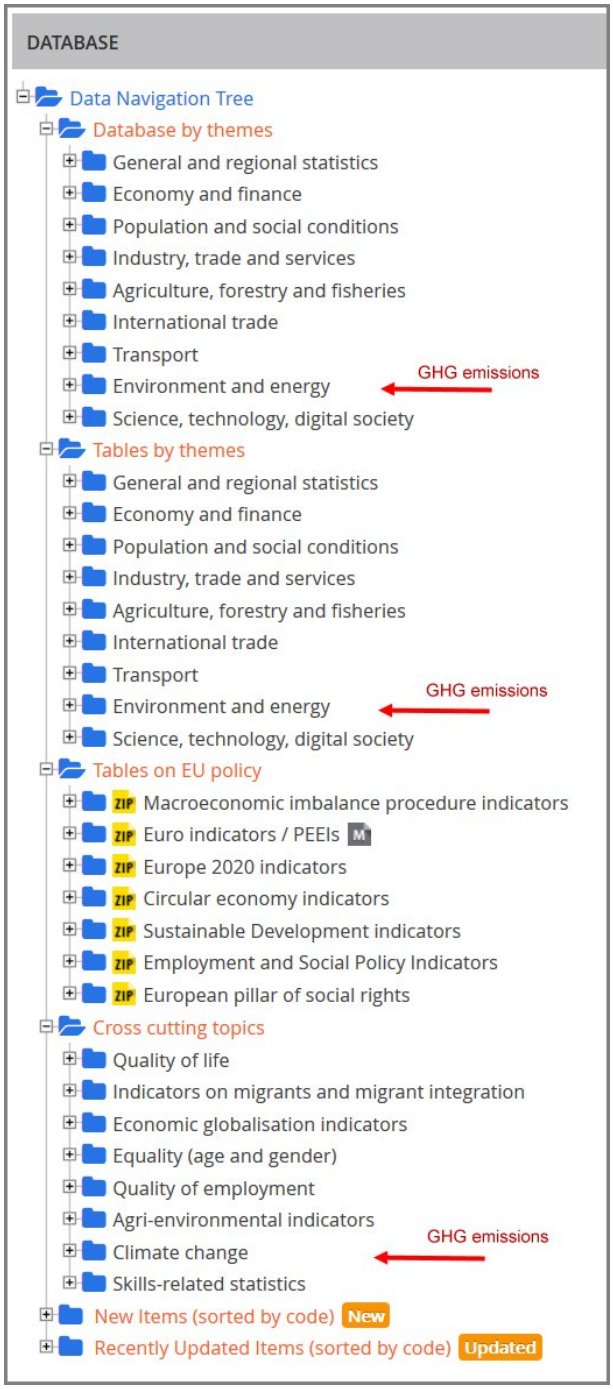


Fig. 8 - The database main structure

Annex 2

Different Emission Definitions

Data for statistics can be selected for different purposes. Therefore, it can be useful to know how data have been selected. Eurostat has published a specification for GHG emissions data: "Statistics Explained. Greenhouse gas emission statistics - emission inventories"[4].

The five main emission source sectors include:

- energy (fuel combustion and fugitive emissions from fuels) — which also includes transport;
- industrial processes and product use;
- agriculture;
- land use, land use change and forestry (LULUCF); and
- waste management.

Eurostat presents three perspectives of greenhouse gas (GHG) emissions statistics:

Perspective	Statistical framework	Purpose
1. GHG emissions classified by economic activities	Air Emissions Accounts (AEA) by Eurostat	tailored for integrated environmental-economic analyses
2. GHG emissions classified by technical processes	GHG emission inventories by UN	official international reporting framework for international climate policies (UNFCCC, EU MMR)
3. 'footprints' = GHG emissions classified by final use of products	Modelling results published by Eurostat	one particular analytical application of AEA

Emissions accounts versus emission inventories

Air emissions accounts – greenhouse gases (residence principle)	Greenhouse gas emission inventories (territory principle)
Emissions are assigned to the country where the economic operator causing the emission is resident.	Emissions are assigned to the country where the emission takes place
Emissions are classified by economic activity, following the NACE classification of the system of national accounts.	Emissions are assigned to processes classified accord- ing to their technical nature (e.g. combustion in power plants, solvent use).
Emissions from international navigation and aviation are assigned to the countries where the operator of the ship/aircraft is resident, regardless of where the emission takes place.	Emissions from international navigation and aviation are assigned to the countries where the associated fuel is bunkered, irrespective of the operator's place of residence.

The term NACE is derived from the French *Nomenclature statistique des activités économiques dans la Communauté européenne*. NACE is the statistical classification of economic activities in the European Union (EU).

[4] http://ec.europa.eu/eurostat/statistics-explained/index.php/Greenhouse_gas_emission_statistics_-_emission_inventories

Annex 3

Breakdown of Danish GHG emissions 2015

Denmark	2015
Emission inventories	1000 tonnes
Energy	34.476
Industrial processes and product use	1.992
Agriculture	10.299
Land use, land use change, and forestry (LULUCF)	4.153
Waste management	1.153
Other sectors	0
Total	52.072

Table 1 - Emission inventories for Denmark 2015

The total emission in fig. 1 matches the 9 tons per capita in fig. 3

Denmark 2015 GHG emissions tonne			
Emission accounts	Carbon dioxide	Methane	Other
Agriculture, forestry and fishing	2.157.029	222.263	15.539
Mining and quarrying	1.748.648	3.280	177
Manufacturing	5.584.787	1.012	146
Electricity, gas, steam and air conditioning supply	9.421.321	7.029	223
Water supply; sewerage, waste management and remediation activities	1.373.073	35.355	634
Construction	1.413.065	45	56
Wholesale and retail trade; repair of motor vehicles and motorcycles	941.650	43	36
Transportation and storage	38.389.996	1.199	1.109
Accommodation and food service activities	111.155	10	3
Information and communication	74.592	5	2
Financial and insurance activities	48.223	3	2
Real estate activities	116.031	4	4
Professional, scientific and technical activities	140.453	8	4
Administrative and support service activities	230.150	8	8
Public administration and defence; compulsory social security	343.224	15	14
Education	146.334	18	5
Human health and social work activities	173.794	23	44
Arts, entertainment and recreation	61.460	6	2
Other service activities	62.357	3	3
Total	62.537.342	270.331	18.009

Table 2 - Emission accounts for Denmark 2015 (All NACE activities)

The breakdown structure in table 2 is different from table 1 because emission accounts are based on economic activities.

Energinet's environmental report[5] confirms the emission from electricity and CHP, which was about 15% of the total Danish GHG emissions in 2015.

[5] Energinet: Environmental report for Danish electricity and CHP for 2017 status year (https://en.energinet.dk/-/media/Energinet/El-RGD/QHSE-CGS/Miljoerapport-2018/Environmental-Report-2018.pdf)