Source: https://commons.wikimedia.org/wiki/File:Greenhouse-effect-t2.svg

Greenhouse Gases

HOW BAD IS IT?

Mairead Manifold
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Contents

Introduction

There is currently considerable mass media attention given to global warming and how it is adversely affecting our planet's future. Greenhouse gases (GHG) are seen as the main culprit in global warming. In an Irish Times article from 2018, the then Taoiseach was quoted saying that over 1/3 of Ireland's emissions came from farming (Irish Times, 2018) and (SEAI, 2020). This article prompted a desire to find how accurate this statement was.

So, the intention of this project is to investigate GHGs and gather information on Ireland's GHG activity in a manner that could be later used to create a blog post or write a magazine article.

The European Commission Eurostat website publishes GHG statistics for Ireland and the rest of Europe. Its data for agriculture includes forestry and fisheries, but there is a breakdown for methane which is generally associated with agriculture, so we will us narrow down the data to this form of agriculture activity (Tagasc:, 2019).

The first task in approaching this topic is identifying the audience (relationship|one, 2020).For the most part, it should be safe to assume that people don't have a deep understanding or knowledge of GHG's science, but they are interested in understanding the overall trends and how much Ireland is contributing to the gases.

Datasets

The main Eurostat dataset used in the project is the "**Emissions of greenhouse gases and air pollutants (env_air)**" (European Commission Eurostat, 2020). It was download as a csv file in a zip file format.

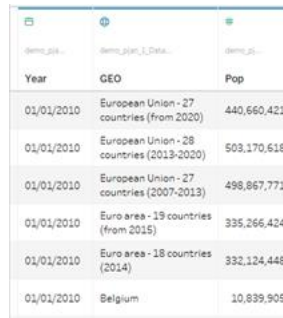The downloaded file was labelled "**env_ac_ainah_r2.zip**".

TIME	GEO	AIRPOL	NACE_R2	UNIT	Value
2009	European Union - 2?	Carbon dioxide	Total - all NACE activities	Tonne	2,728,199,826
2009	European Union - 2?	Carbon dioxide	Agriculture, forestry and fishing	Tonne	94,638,521
2009	European Union - 2?	Carbon dioxide	Mining and quarrying	Tonne	30,182,348
2009	European Union - 2?	Carbon dioxide	Manufacturing	Tonne	761,753,974
2009	European Union - 2?	Carbon dioxide	Electricity, gas, steam and air conc	Tonne	1,096,532,078
2009	European Union - 2?	Carbon dioxide	Water supply; sewerage, waste m	Tonne	36,769,605
2009	European Union - 2?	Carbon dioxide	Construction	Tonne	50,773,426
2009	European Union - 2?	Carbon dioxide	Wholesale and retail trade; repair	Tonne	72,819,084
2009	European Union - 2?	Carbon dioxide	Transportation and storage	Tonne	415,475,398
2009	European Union - 2?	Carbon dioxide	Accommodation and food service	Tonne	17,641,742

Figure 1 - Greenhouse Emissions Eurostat Dataset

The greenhouse dataset shows the level with which various activities (NACA) contribute to air pollutants: Carbon Dioxide (CO_2), Nitrous Oxide (N_2O) and Methane. The dataset has 23,101 rows for the years 2009 to 2018, for all 28 of countries in Europe. Due to gaps in some of the data for 2018, the project focused on the year 2017 because it offers a more

complete set of data. To use the dataset in Tableau, it was necessary to change the format of the TIME field to a date format and the GEO field to a geographical reference. The Value field was changed to a numerical reference and to a measure. TIME was renamed to YEAR and converted to a dimension.

To calculate per capita values for the greenhouse dataset, a population dataset "**demo_pjan_1_data**" from the Eurostat website was used. Its fields were stripped down, renamed and reformatted to enable a join based on the country field so that the per capita calculation could be calculated on the GHG.

Year	GEO	Pop
01/01/2010	European Union - 27 countries (from 2020)	440,660,421
01/01/2010	European Union - 28 countries (2013-2020)	503,170,618
01/01/2010	European Union - 27 countries (2007-2013)	498,867,771
01/01/2010	Euro area - 19 countries (from 2015)	335,266,424
01/01/2010	Euro area - 18 countries (2014)	332,124,448
01/01/2010	Belgium	10,839,905

Figure 2 - Population Eurostat Dataset

The population dataset has 591 rows with populations details for the years 2010 to 2019. The average population in each country was used to calculate per capita emissions for the 'Visual 4 – Table – Europe's per capita GHG 2009 – 2017 ' visual.

To create the ' Visual 8 – Sunburst - Worldwide GHG ' visual, the dataset "**annual-co-emissions-by-region.csv**" was downloaded from the ourworldindata.org website and created into Excel. All the other visual were creates in Tableau.

Entity	Code	Year	Annual CO
Afghanist:	AFG	1949	14656
Afghanist:	AFG	1950	84272
Afghanist:	AFG	1951	91600
Afghanist:	AFG	1952	91600
Afghanist:	AFG	1953	106256
Afghanist:	AFG	1954	106256
Afghanist:	AFG	1955	153888
Afghanist:	AFG	1956	183200

Figure 3 - Worldwide GHG Emissions, Source: (Our World in Data, 2019)

This dataset has 20,854 rows with records going back to the 1800s. The dataset was converted into a table in Excel which allowed for easy conversion to the sunburst diagram.
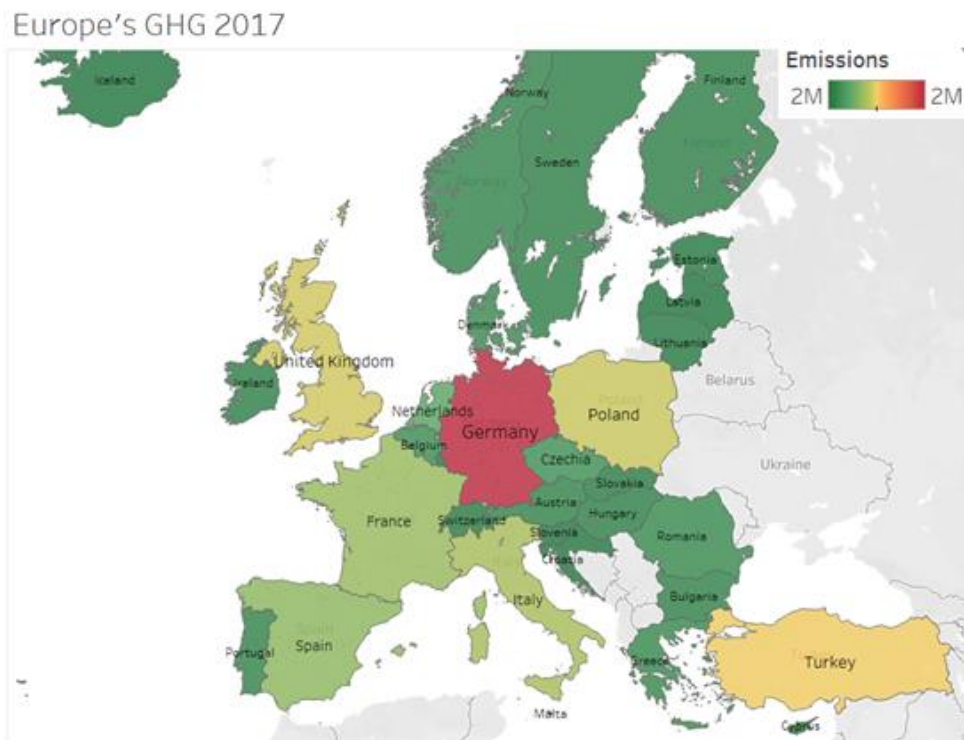
Visual 1 – Map - Europe's GHG 2017

Figure 4 – Map – Europe's GHG (Tonnes) 2017

The first visual is a map of GHG in Europe in 2017. This was chosen as a good place to start to set the scene for the project. Maps are a simple and powerful means of communicating information. Most people can easily relate to a map. You can see from map, Ireland despite its small size is on the higher end of contributions to GHG. Coloured maps do have the disadvantage that they don't suit colour-blind people, so this is one of their limitations. This map was tested in PowerPoint and converted to greyscale to see how it would appear for a colour-blind person. See Figure 5 – Map – Europe's GHG (tonnes) 2017 – Greyscale.

Figure 5 – Map – Europe's GHG (tonnes) 2017 – Greyscale
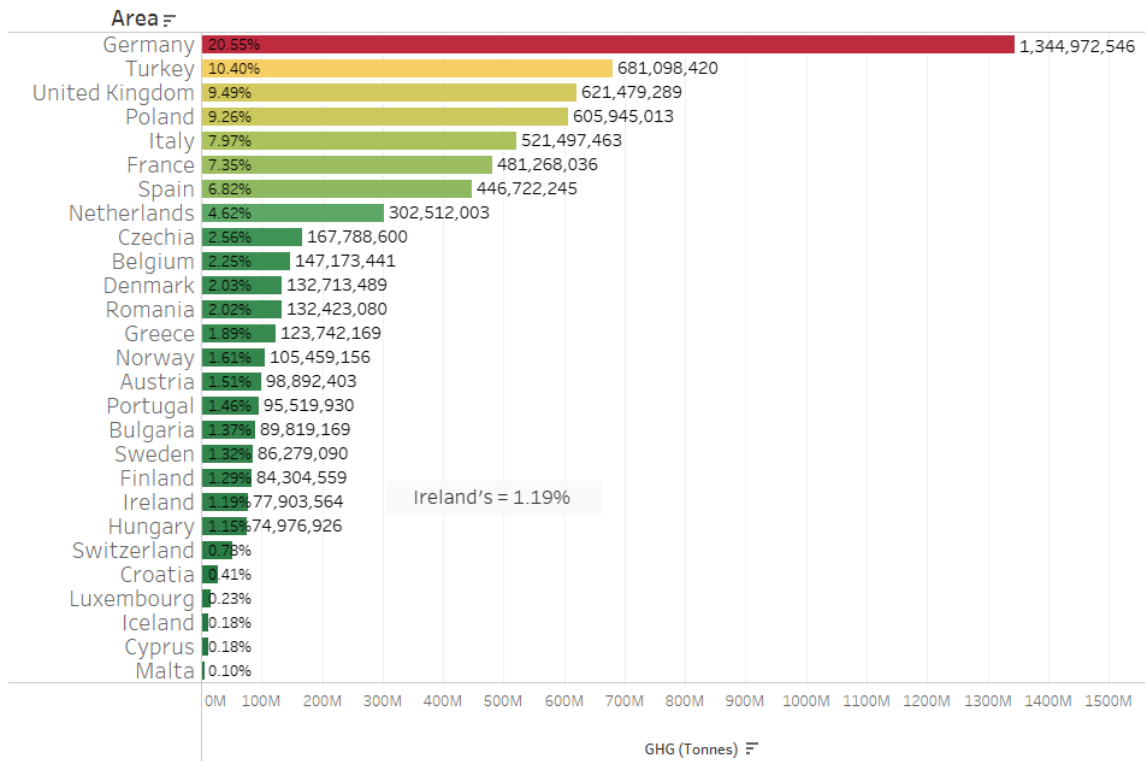
Visual 2 - Table – Europe's GHG 2017

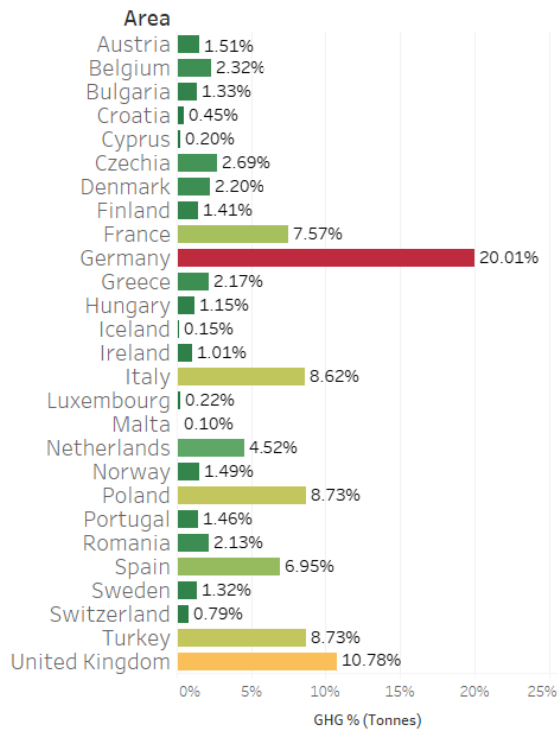*Figure 6 – Table Europe's GHG 2017*

Although Visual 1's map was a good scene setter, it was quite limited in the information it provided to the viewer. The table in Figure 6 – Table Europe's GHG 2017 is considerably more informative. It includes concrete numerical details on GHG tonnes for each country plus percentage details so you can compare the relative contribution of each country. The chosen colour scheme was Red-Gold-Green-Diverging in reverse mode, as the colour scheme green to green to red seems a good match for what is going on in the environment as GHG go from low amounts(green) to high amounts(red). This provided us with a colour scheme that has a meaning, which is always desirable. Being mindful that "Colours are perhaps the visual property that people most often misuse in visualisation without being aware of it" (Andy Kirk 2016, 2016), we aimed to use the same colour scheme throughout the project to avoid unnecessary misuse and overcolouring. The same colour scheme was used throughout the project, and similarly for text and font formatting to add a seamlessness to the project's presentation.

In Visual 2, an annotation highlighting Ireland's 1.19% contribution was added to the table to focus the viewer's attention to this important piece of information.

Visual 3 - Table – Europe's GHG 2009 – 2017

Looking at statistics at a particular point in time has its limitations. You sometimes need to view what happens over time to fully appreciate the facts behind the statistics.
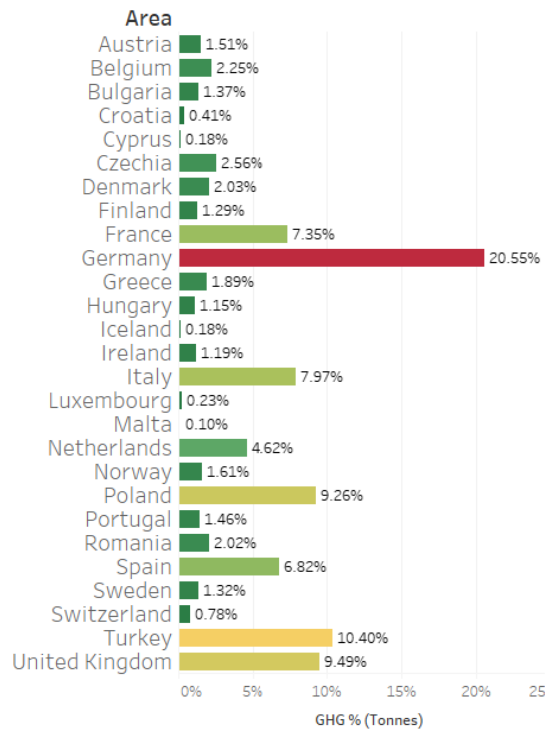

Figure 7 - Table – Europe GHG 2009 – 2017

Visual 3 allows you to do this. Two different graphs are placed side by side to convey the progression of GHG between 2009 and 2017. The countries are listed alphabetically to make is easier to compare the two dates. Ireland's contribution to GHG as a % of the total represented by the countries listed in this chart went up between 2009 and 2017. Ireland does not compare well with the other countries. Notice that Ireland's neighbour UK's went down from 10.78 to 9.49%. But these percentages do not reveal actual GHG. The next chart Visual 4 reveals this information.
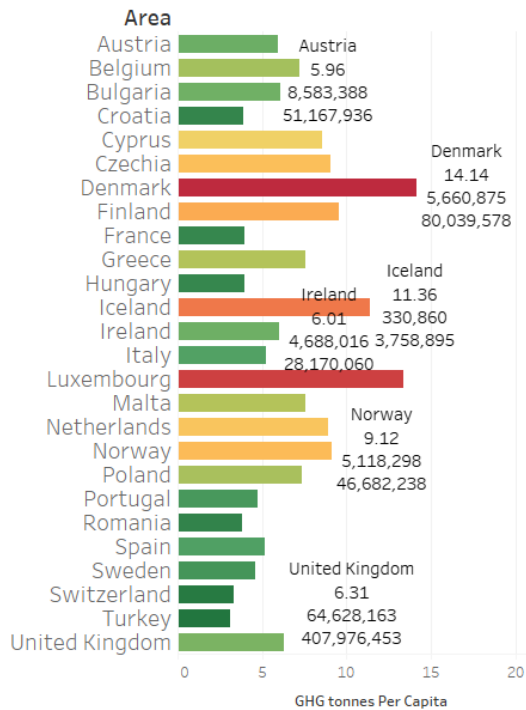
Visual 4 – Table – Europe's per capita GHG 2009 – 2017
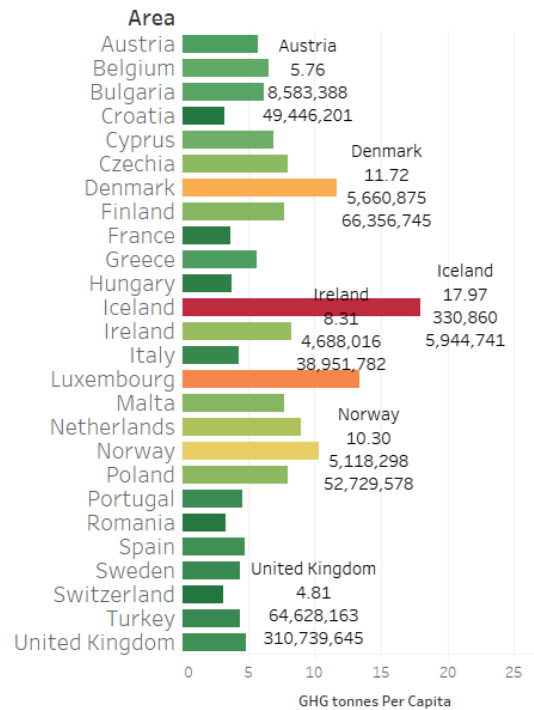
Figure 8 - Table - Europe's per capita GHG 2009 – 2017

While the % figures in Visual 3 provided some insight into Ireland's performance in terms of GHG in Europe, it was not informative about actual GHG emissions or per capita figures. This chart completes that picture of Europe's GHG emissions. You can read the tonnes from the X axis, but the addition of annotations adds a deeper understanding of the GHG emissions. The annotations show per capita emissions, population and actual emissions so the viewer can verify the per capita calculation. Ireland's per capita emissions increased by almost 40% between 2009 and 2017 while UK's went down by around 25%.

Visual 5 – Pie Chart – Ireland and Europe's GHG Activities
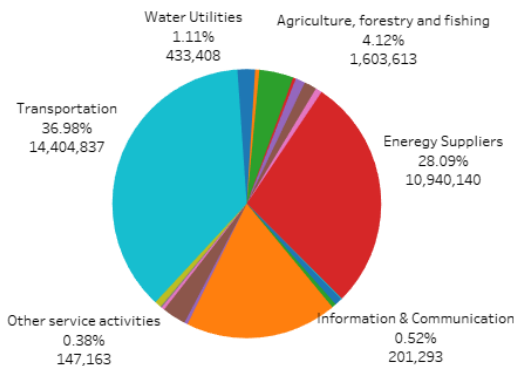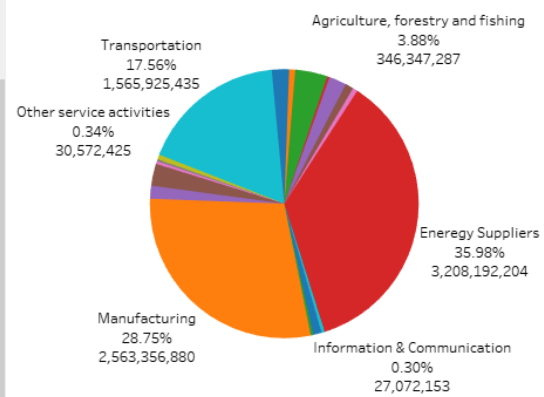
Figure 9 - Pie Chart - Ireland & Europe's GHG Activities in % & Tonnes

Having so far looked at Europe's and Ireland's GHG emissions, a deeper look at GHG emissions between various economic activities is shown in these pie charts. A pie chart format was chosen for this visual as pie charts are an ideal chart style when the emphasis is on % and there are a limited number of records and it takes advantage on the pre-attentive attribute of length (FusionCharts, 2014). Annotations are added to more fully communicate the information contained within the chart. As we can see from chart, Ireland's agriculture share is 4.12% whereas Europe's share is slightly less at 3.88%. This statistic for Ireland is far off from the 1/3 mentioned in the Irish Times article (Irish Times, 2018).

Visual 6 – Line - Ireland & Europe's Agriculture GHG 2009 to 2017

Ireland's Agriculture, forestery and fisheries GHG 2009 to 2017

Europe's Agriculture, forestery and fisheries GHG 2009 to 2017

Emissions

2M ████ 2M
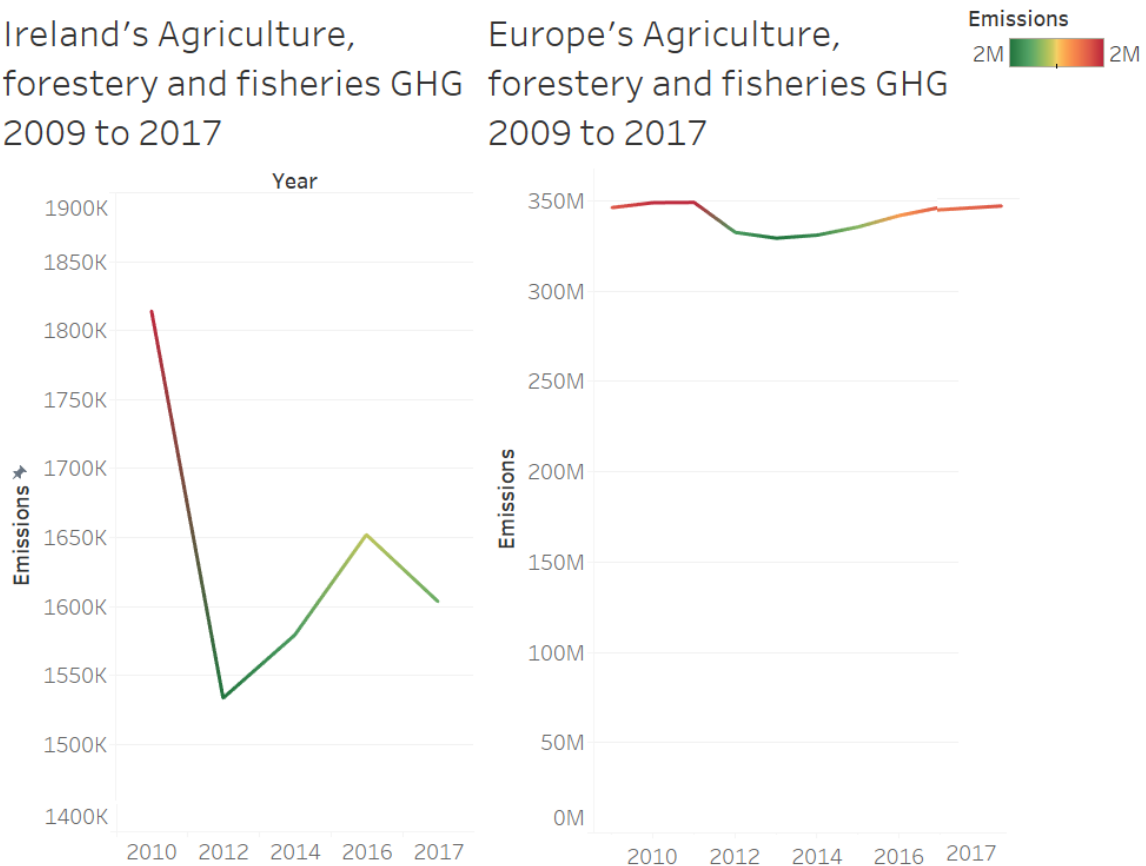
Figure 10 – Line - Ireland & Europe's Agriculture GHG 2009 to 2017

In this visual, a line chart is used to compare Ireland's and Europe's GHG in relation to agriculture, forestry and fisheries for the periods 2009 to 2017. Line charts are an effective chart style for time series. Is Ireland's dip in 2012 related to the global crash or something else? Agriculture, Forestry and Fisheries declined in 2012 too. The Y – axis scale in the two graphs are different so not comparing like with like, but it still shows a trend comparison.

Visual 7 – Table - Europe's Methane GHG Emission 2012 – 2017

Europe's Methane Emissions 2017

AIRPOL	Area	Methane	% of Total
Methane	Austria	190,227	1.73%
	Belgium	238,071	2.17%
	Bulgaria	32,232	0.29%
	Croatia	61,264	0.56%
	Cyprus	12,298	0.11%
	Denmark	222,689	2.03%
	Finland	102,709	0.94%
	France	1,542,558	14.05%
	Germany	1,341,602	12.22%
	Greece	179,095	1.63%
	Hungary	110,295	1.00%
	Iceland	14,464	0.13%
	Ireland	518,728	4.72%
	Italy	792,505	7.22%
	Luxembourg	18,750	0.17%
	Malta	1,292	0.01%
	Netherlands	541,668	4.93%
	Norway	104,628	0.95%
	Poland	597,656	5.44%
	Portugal	183,244	1.67%
	Romania	509,241	4.64%
	Spain	991,218	9.03%
	Sweden	132,760	1.21%
	Switzerland	161,355	1.47%
	Turkey	1,350,543	12.30%
	United Kingdom	1,028,188	9.36%

Figure 11 – Table Europe's Methane GHG Emission 2017

For the year 2017, Figure 11 table shows Methane GHG emissions. Ireland's 518,728 tonnes make up 4.72% of Europe's methane emissions. The inclusion of % and colour in this table is an effective means of simplifying the complexity of information being presented in the table. Methane is generally associated with agriculture, so this statistic is proportionately high for Ireland's size and population. Ireland's high contribution to methane should be understood within the overall context of methane % for all Europe's GHG, see Figure 12 - Europe's Methane % for all GHG.

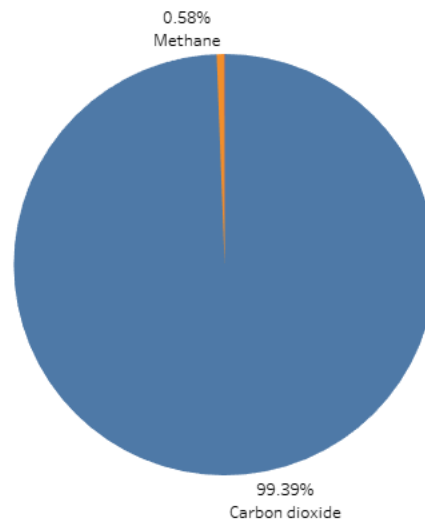## Europe's Agriculture Methane 2017

Figure 12 - Europe's Methane % for all GHG

From Figure 12, we can see that Methane makes up a small proportion of all GHG in 2017. From the chart, we can see that CO2 is by far the biggest factor in Europe's GHG for the year 2017. A pie chart is quite an effective way of highlighting something as significant as a tiny proportion.

Visual 8 – Sunburst - Worldwide GHG

The Irish Times article (Irish Times, 2018) claim that over 1/3 of Ireland's emissions come from farming is at odds with the GHG data downloaded from the Eurostat website. There are clearly discrepancies in the source (SEAI, 2020) for this article. There needs to be clarification on what constitutes an agriculture activity in the SEAI source calculation. However, despite any discrepancies in the data, there is no denying that GHG is a worldwide problem. Ireland is part of Europe, and Europe is part of the world. Any damage to the environment by GHG in Ireland or Europe is a damage to the world's environment. GHG do not have borders.
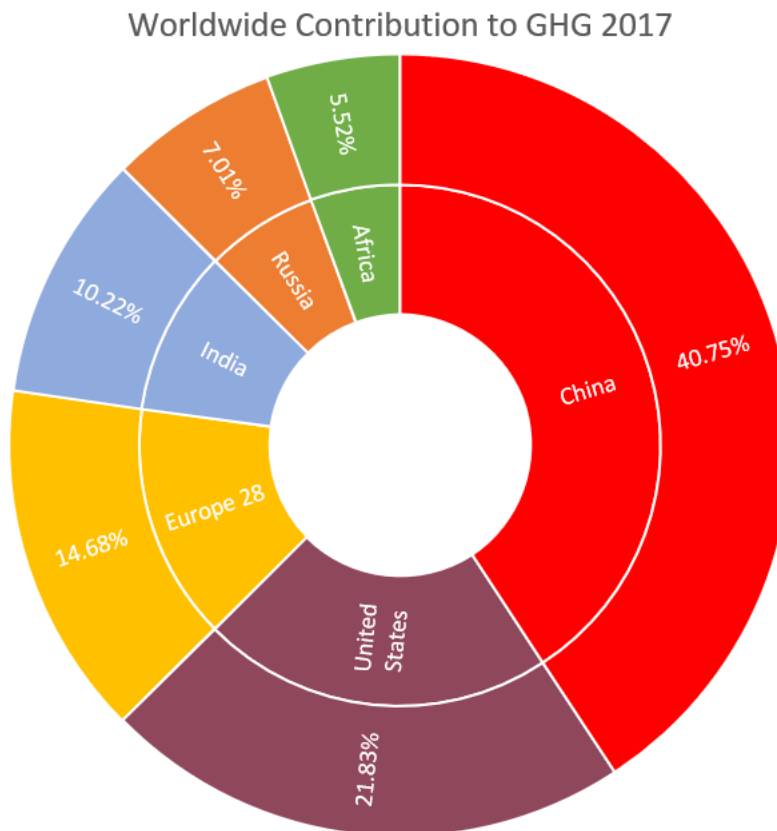
Figure 13 - Sunburst Worldwide GHG

Source: (Our World in Data, 2019)

This sunburst diagram clearly shows that China is not the only major contributor to GHG emissions. All continents/countries have a responsibility and their shares are high too. The sunburst was built in Excel. It was chosen instead of the doughnut type, which was originally planned because it was felt it presented the information in a clearer and more effective manner. The default font size in the sunburst was too small so it had to be increased from 9 to 14 points. The default colours were changed for China, giving it a red

colour and giving the United States a purple colour, somewhat in line with the colouring used elsewhere in the report.

Infographic

When considering the approach to designing the Infographic, we recalled "*The goal is to transform data into information, and information into insight"* (Fiorina, 2004) and " Dieter Rams was becoming increasingly concerned by the state of the world around him – "*an impenetrable confusion of forms, colours and noises*." Aware that he was a significant contributor to that world, he asked himself an important question: **Is my design good design?**" (VITSOE: Design Deiter Rams, 2020)**.** Both these quotes inspired the project to design an infographic that had a simple message and presented the essential details discovered during project's research. The infographic presented Europe's GHG emissions within the world's emission rates and showed how Ireland's % overall GHG emission is proportionate to its size. Choosing few charts and diagrams, but a range of simple objects such as map, icons (binoculars, tractor and cloud), popups and short statements, the infographic aimed to present condensed facts in a trustworthy, accessible and elegant manner (Andy Kirk 2016, 2016).

The infographic highlights how agriculture, forestry and fisheries GHG emissions are above average, but that methane is a small proportion to other GHG emissions, so the dairy industry in Ireland should not feel their contributions are anywhere near the 1/3 of Ireland's emissions as stated in the Irish Times article (Irish Times, 2018). Obviously, much more research needs to be conducted to reveal the full facts surrounding Ireland's GHG emissions.

Conclusion

The motivation behind this project was to shed light on Ireland's GHG emissions. The aim of the project was come up with visuals that adequately communicate research findings and to use the knowledge learnt in the Data Visualization in choosing and creating the visuals.

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Greenhouse Gases (GHG) - 2017

European Union

IRELAND

Northern Ireland Belfast

European Union (Brussels)

IRELAND

EUROPE

HOW IS EUROPE DOING?

67% of USA's

36% of China's

USA 2017
5,269,529,513 tonnes

EUROPE 2017
3,543,683,484 tonnes

China 2017
9,838,754,028 tonnes

IRELAND'S FACTS

Ireland's Greenhouse Gases in 2017 was 77,903,64 tonnes

1.16 % of EU's Greenhouse Gases

IRELAND GREENHOUSE GASES

Agriculture, Forestry & Fisheries in Europe was 346,347,287 tonnes

3.88% of EU's Greenhouse Gases.

AGRICULTURE EUROPE

Agriculture, Forestry & Fisheries in Ireland was 1,603,613 tonnes

4.12% of Ireland's Greenhouse Gases

AGRICULTURE IRELAND

In Europe, Carbon Dioxide made up 99.39%, Nitrous Oxide made up 4.35% and Methane made up .58% of GHGs.

In Ireland, Carbon Dioxide made up 98.52%, Nitrous Oxide made up 3.87% and Methane made up 1.43% of GHGs

CO_2, N_2O, Methane